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THE PROBLEM OF ANTIQUITY OF MAN IN AUSTRALIA.

By D. J. Mahony, M.Sc.,
Director, National Museum of Victoria.

Plates I-III.

To appreciate what is meant by antiquity of man, the significance of the term antiquity in this connection should be considered. The word may be used in the historical or in the geological sense. In the historical sense it applies to events or to man's handiwork during early Egyptian and Mesopotamian civilizations or even later; in the geological sense it involves much longer periods of time. The earliest historical traditions are generally supposed to date back 7,000 years; but the Pleistocene period is estimated to have ended some 15,000 or 20,000 years ago and all that has happened since then is geologically recent. In Europe the earliest fossil human bones are probably 130,000 years old, and the oldest stone implements 400,000 years. To grasp what these figures mean we may imagine ourselves walking down the avenue of time into the past and covering a thousand years at each pace. The first step takes us back to William the Conqueror, the second to the beginning of the Christian era, the third to Helen of Troy, the fourth to Abraham and the seventh to the earliest traditional history of Babylon and Egypt; but we have to continue more than twice as far before leaving geologically recent (Holocene) times and entering the Pleistocene period, 130 paces to Heidelberg man, and about a quarter of a mile to the oldest undoubted stone implements of Europe. Should we decide to continue our journey until we meet the most ancient fossil organisms, we would probably require a time-car, for the journey on the same scale would exceed 250 miles according to the latest estimates.

There is convincing evidence of the historical antiquity of man in Australia, and good reason to believe that he migrated there before the end of Pleistocene times. The data are set out in the following pages.

The problem is bound up with several others. Before Europeans arrived two types of mankind inhabited the Australian region, one being confined to the mainland, the other to Tasmania. Tasmanians, now extinct, differed from Australians in physical appearance and in cultural level. What are the affinities of these

two types with other races of mankind and with each other? Are they mixed or pure races? These are problems for physical anthropologists. The few fossil skulls found in Australia have Australoid or Tasmanoid characteristics, and there are no fossil remains that suggest that the Australian region was ever occupied by other types of mankind before the arrival of modern Europeans. The Australian wild dog, the dingo, was the only large terrestrial placental mammal, man excepted, living in the area and it is confined to the mainland. What are its affinities with other species of dog? Could it have evolved in Australia? If not, where did it come from? Did it find its way overland unassisted by man or did it come as the domestic dog of human immigrants who crossed stretches of sea by canoe? These are problems for zoological systematists and palaeogeographers, and the answers are of some importance since fossil dingo bones have been found associated with remains of extinct marsupials in deposits that suggest some geological antiquity. Did the Tasmanians once occupy the mainland of Australia or did they go direct to Tasmania from some other locality such as New Caledonia? If they migrated from Australia, did they do so by a land-bridge which once joined island and mainland, or by canoe after the land-bridge disappeared? If they once occupied the mainland and were later partly exterminated, partly absorbed by an invasion of Australoid migrants, do Australian aborigines retain traces of the racial intermixture? Geologists and anatomists can furnish the answers. Finally, we must assess the value of evidence for antiquity of human bones and artefacts found embedded beneath the surface; it must be based on knowledge of the relative ages of Pleistocene and Holocene horizons in Australia and their correlation with similar horizons in the northern hemisphere. This is the province of geologists.

The literature on these subjects is widely scattered in books and scientific periodicals, and no comprehensive statement of the problem of antiquity of man in Australia as it now stands has been published. In view of the recent discovery in a river terrace at Keilor near Melbourne of the fossil human skull (Pl. I) which is described elsewhere in this volume by Dr. J. Wunderly and Dr. Wm. Adam, as well as a second skull and limb bones, an attempt is made in the following pages to summarize current opinions on the subjects. These are widely divergent, and the problems offer an attractive field for further research.

Many further references to Australian Post-Tertiary geology could be added to the bibliography, but those selected will suffice for a general survey of the subject.

Australians and Tasmanians

Wood Jones (1935 b) summarized the most generally accepted current opinions on racial affinities of Australian aborigines. He said that the Australian belongs to the Dravidian race; he is not a black man nor does he have fuzzy hair; he is a member of the straight- or wavy-haired, brown-skinned race that has no near kinship with the true negro. The physical characters, blood groupings and culture of Australians all point to them as being the advance guard of the great pre-Dravidian migration that, starting probably in the Mediterranean region, spread across India into Ceylon and then to the Malayan region. With the Veddas of Ceylon and with other scattered remnants of this migration the Australian native has very real affinities.[1]

Wood Jones (1935 a) also gave a summary of what is known of the extinct Tasmanians. He said that in colour the Tasmanian was so dark a shade of brown that casual observers described him as black. The scalp hair was black and grew as crisp, frizzy little curls, but unlike the true peppercorn hair of the African negro, the hair of the Tasmanian grew to a considerable length. The average height of the men was five feet five and a quarter inches, more than an inch less than that of the average male Australian. The Tasmanian, according to him, was a primitive Negroid.[2]

Meston (1936) pointed out that Tasmanians had the dark skin, flat nose and wide nostrils adapted to hot climates, but disadvantageous in cool-temperate regions such as Tasmania; David (1924) also noted this point. The inference is that the race evolved under tropical conditions and migrated to Tasmania at a fairly late stage of its evolutionary history.[3]

Some investigators, however, have expressed other views concerning the racial affinities of Australians and Tasmanians.

Turner (1908) held that Australians and Tasmanians belong to distinct races, but a proportion of natives in southern and western Australia have skulls that point to possible intermixture and racial affinity with Tasmanians; he inferred that the Tasmanians were direct descendants from a primitive Negrito stock and had become specialized in many ways as a result of long isolation. Klaatsch (1908) considered that Australian aborigines are a relic of the oldest type of mankind. Keith (1910) concluded

1. For blood grouping see Cleland, Cleland and Johnston, Tebbutt, Tebbutt and McConnel, Lee, Birdsell and Boyd, Phillips, and F. J. Fenner (1939); for descriptions of skulls, Berry and Robertson, Buchner, Burkitt, Burkitt and Hunter, Fenner, Hrdlička, Howells, Klaatsch, Morant, Robertson, Shellshear, Wagner, and Wood Jones; for teeth and palate, Campbell.

2. For descriptions of Tasmanian skulls see Berry and Robertson, Büchner, Crowther and Lord, Hrdlička, Morant, Ramsay Smith, Turner, Wagner, Wood Jones, and Wunderly; teeth and palate, Campbell (in Wood Jones, 1924).

3. See also Davies (1932).

that the Tasmanian is the most primitive type of Negro and the Australian the most primitive type of Negroid. According to Berry and Robertson (1914 a), Mollison's variation index shows that Tasmanians and Australians belong to a common stock, and that the Australian agrees much more closely with an admittedly mixed race such as modern Italians than with supposedly pure stocks such as Andamanese and Tasmanians; and that the Australian, as regards skull type, is less highly evolved morphologically than the Tasmanian. Sollas (1924) suggested that the Tasmanians are survivors of a primitive race elsewhere extinct or merged into a predominant alien population, and that the Australian is a survival from Mousterian times, but not a direct descendant of the Mousterian races of Europe. Hrdlička (1928) said that the Tasmanian is probably a mere local variant of the Australian. F. J. Fenner (1939), after examining in detail 1182 adult Australian skulls, divided them into three sub-types; two of these, occurring respectively in the coastal Northern Territory and the Queensland areas, are differentiated from the common southern type, which occurs over the greater part of Australia. He considers that these types are probably due to two factors: (a) fusion of Australoids with Tasmanoids, and (b) a later wave of Papuan and possibly Malayan infiltration into the northern part of the continent. He also considers that blood grouping, if reliance can be placed on the data, suggests that Melanesian infiltration has penetrated a considerable distance southward. Wunderly (1938 a, b), from an examination of Tasmanian skulls and other evidence, concluded that the Tasmanians were Negritos, but that the natives of the west coast were a mixed race of Tasmanian-Australian origin due to migration of Australian aborigines to this part of Tasmania one or two generations before Europeans arrived. Howells (1937) discussed various theories; that Australia represents the original home of mankind; that the Australians are descended from Neanderthal man; and that they are the product of a mixture between (a) a "White" and a Negrito or Negro stock, (b) two differing Negroid strains, or (c) Tasmanian and Polynesian. He considers that the Australian represents an earlier stage in the development of *Homo sapiens* than does any other existing race. From a survey of several hundred skulls of Pacific Ocean peoples, Wagner (1937) included the peoples of Tasmania, Australia, Melanesia and New Guinea in one large Australoid-Melanesian group. Craniological agreement which binds together this group includes many similarities, but not in all characters; some well-defined types, such as Australians and Tasmanians, can be demonstrated within the group. He says

that the Australian type extends throughout Australia, but there is some variation, probably due to migration of Melanesian people from the north, so that Australian skulls fall into six sub-types found respectively in Northern Australia, Queensland, West Australia, South Australia, New South Wales and Victoria. The similarity of Tasmanian and Australian skulls is striking, the Tasmanians being closer to the West Australian sub-group than to any of the others. Possibly an original Tasmanoid population in Australia was driven west and south by later incomers.

It is generally agreed that mankind and all other placental mammals originated outside the Australian region.

The ancestors of both Australian and Tasmanian aborigines no doubt reached Australia by way of that avenue of migration along which many races of mankind have passed towards the Pacific—the Malay Peninsula, Sumatra, Java, and New Guinea. Some Australoid and Negrito tribes are found among the races inhabiting Malaya and New Guinea. The fact that an Australoid skull of some geological antiquity has been found in New Guinea (F. J. Fenner, 1941), and that ancient Australoid skulls (Wadjak man) have been described from Java by Dubois (1920), lends strong support to the theory that the forefathers of the Australian race migrated along this route in the distant past. Dubois's claim that Wadjak man is of Pleistocene age has not been substantiated (von Koenigswald, 1937).[4]

Huxley, Wood Jones, Pulleine and others hold that the Tasmanians voyaged from New Caledonia; Howitt, Haddon, Wunderly, Meston and others consider that they migrated from the mainland of Australia across a land-bridge or by canoe. Howitt (1898) pictured both Tasmanians and Australians as arriving in Australia by way of a land-bridge formerly connecting Asia and Australia, which was broken at Wallace's line by a narrow stretch of sea that might be crossed in vessels no better than modern Australian bark canoes, the Tasmanians arriving first and occupying Tasmania while it still formed part of the mainland. Tindale and Birdsell (1942) claim that small tribes with Tasmanian affinities survive in the Atherton rain jungle, North Queensland; possibly, however, these tribes may have originated by infiltration of people from New Guinea or adjacent islands. The Keilor skull, which combines Tasmanian with Australian characteristics, supports the theory that Tasmanians once occupied the Australian mainland.

During Pleistocene glacial phases sea level fell, and Tasmania was connected or almost connected by land with Victoria; in

4. See also Fromaget (1940 a, b) and Mijsberg (1940).

interglacial periods it rose and the two were separated by water. There has probably been no land-bridge since mid-Pleistocene times; the reasons for this opinion are given in a later page. Under present conditions, the chain of islands between Wilson's Promontory and Tasmania provides an easy route for migration by boat, with no stretch of open water exceeding 30 miles and land in sight across every gap. Tasmanian canoes were very primitive, but the natives used them for visiting Tasman, Maatsuyka and other islands separated from Tasmania by stormy seas.

The Dingo

At one time it was considered that the dingo is a distinct species of dog peculiar to Australia (Etheridge, 1916), but Wood Jones (1921) demonstrated that it is merely a variety of the domesticated dog, *Canis familiaris,* with no claim to separate specific rank, and this opinion is endorsed by other zoological systematists. He says that the restricted genus *Canis* differs in dentition from the wild dogs of south-eastern Asia, the most probable immigrants in a "walk overland" colonization. He holds that the supposition that the dingo is indigenous, that its phylogenetic story was unfolded within the confines of Australia, is untenable, and when we come to inquire into the possibility of the dingo arriving in Australia unassisted by, and unassociated with, man, we are forced to own that the difficulties of the problem have not always been appreciated by those who have advocated this solution, for no land-bridge that could have admitted either the dingo or man, separately or in company, could have failed to be the high road of entry of a host of other placental mammals. "The progenitor of Talgai man came with his wife, he came with his dog, and with his dog's wife, and he must have done the journey in a seaworthy boat capable of traversing this unquiet portion of the ocean with his considerable cargo. Besides this living freight, and the food and water necessary for the adventure, he carried other things—he carried a knowledge of the boomerang, of the basis of the totem system, and various other cultural features, all bearing a strange suggestion of very distinctly western origin."

No trace of the dingo, living or fossil, has been found in Tasmania nor in the islands of Bass Strait, so it apparently did not reach south-east Australia until the land-bridge between Tasmania and the mainland had disappeared, and it did not accompany the Tasmanians as their domesticated dog.

Few human relics have been found associated with *Diprotodon, Thylacoleo* and other extinct marsupials, but fossil bones of the dingo occur with them in several places.

The Pleistocene Period

The outstanding feature of the Pleistocene or Quaternary Period is the series of rhythmic alternations from cold to mild climates which gave rise to glacial and interglacial phases. During the maximum glaciation, ice-caps covered most of northern Europe, America and Asia, and also Tasmania. Most glaciologists consider that glacial and interglacial phases were contemporaneous in both hemispheres. In Europe four glacial phases were separated by mild interglacial intervals and were succeeded by the present post-glacial phase. Some authorities, however, hold that there were more than four glacial epochs in North America; others consider that the two first glacial phases are Pliocene, not Pleistocene, in age (Boule, 1923), but this is merely a question of nomenclature. Interglacial phases probably lasted longer than glacial, and the second interglacial period greatly exceeds the others; to this period the oldest undoubted relics of mankind belong.

Several theories have been advanced to explain these climatic alternations, but none is generally accepted.

Changes in relative levels of land and sea are due to one of two causes or to a combination of both: increase or decrease in the volume of the oceans (eustatic changes), and local elevations or depressions of the earth's crust (tectonic movements). In Pleistocene times tectonic movements have been negligible in considerable areas.

During glacial phases, withdrawal of vast quantities of water from the oceans to form ice-caps and glaciers lowered sea level; in interglacial times ice melted and sea level rose. Interglacial climates must have been milder than the climate of to-day since strandlines then formed are now raised beaches owing to eustatic changes in sea level.

Daly (1934) estimated that the melting of existing Antarctic and Greenland ice-caps and existing glaciers would cause sea level to rise about 130 ft., but he pointed out that change in level would not be equal throughout the oceans for three reasons: redistribution of load on the elastic terrestrial globe causing deformation; slow transfer of plastic deep-seated matter consequent on that deformation; and cessation of gravitational pull on adjacent ocean waters by ice-caps. For the same reasons, the estimated quantity of water withdrawn or set free during glacial and interglacial phases can give only a rough indication of corresponding changes of sea level in any particular locality.

During glacial phases boulder-clay (tillite) accumulated beneath ice-caps, terminal moraines were formed at the margins of ice-

sheets and glaciers, and fluvio-glacial sands and gravels (outwash-aprons) spread beyond the moraines. Lowering of sea level changed parts of the continental shelves into dry land and exposed large areas of sand which was then blown by the wind and gave rise to dunes. In cold dry areas thick beds of dust (loess) accumulated, as they are doing to-day on the steppes of Southern Russia and Siberia; other regions, now arid, had abundant rainfall. River erosion became active and river valleys were deepened in response to low sea level.

During interglacial phases sea level rose, low-lying country was submerged, and new coast lines were established at higher levels. The flow of rivers was checked and alluvium was deposited in their valleys.

In response to these climatic and geographic changes, plants and animals, including mankind, migrated to and fro. Some species died out; of the genus *Homo* only *H. sapiens* survived.

Daly (1925) considered that in post-glacial times a world-wide strandline at about 10-20 ft. above present sea level was formed during a slight general fall in temperature about 4,000 years ago when water was abstracted from the oceans to thicken existing ice-caps; Milankovitch's radiation curve indicates about 10,000 years. Wright (1937), however, has brought forward evidence to show that the 15-foot raised shoreline of Western Europe is pre-glacial, not post-glacial nor interglacial.

In many regions evidence of the early glacial and interglacial phases has been obliterated wholly or in part by erosion during succeeding phases, and correlation of raised beaches with river terraces, and of drowned valleys with glacial phases consequently presents many problems. The highest raised beaches due to eustatic changes are not necessarily the oldest, but they must rather be correlated with the mildest interglacial phase.[5]

If climate is governed by periodic changes in the orbit of the earth, there are astronomic data for estimating Pleistocene chronology in years (Zeuner, 1935); the method is based on detailed stratigraphical investigations of glacial deposits, river terraces and loess in Central Europe, and on Milankovitch's (1930) solar radiation curve (Fig. 1). This curve (Fig. 1) is the mathematical solution of a problem in astronomy concerning periodic changes in some elements of the earth's orbit that cause corresponding fluctuations in the total radiation received by the earth from the sun. The period covered is the past 600,000 years. Changes in Pleistocene climates indicated by the full geological

5. For general accounts of the Pleistocene, see Boule (1923), Sollas (1924), Daly (1934) and Wright (1937).

record correspond so closely to maxima and minima in the solar radiation curve that there seem to be sound reasons for correlating them. In Central Europe there were four Pleistocene glacial phases—the Würm, the Riss, the Mindel and the Günz—each with

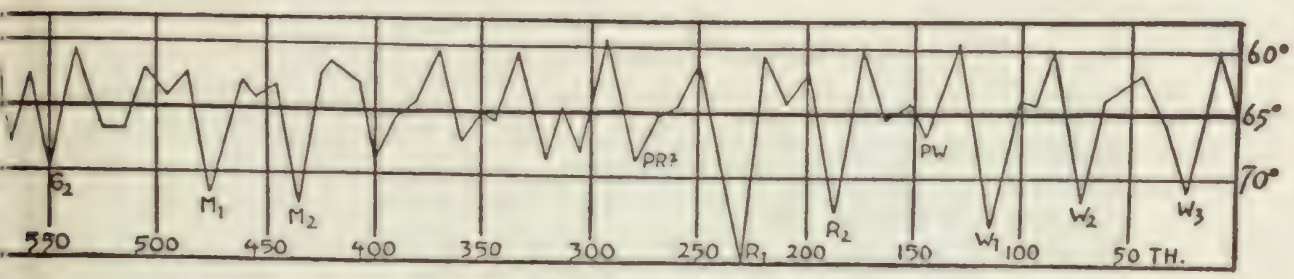

FIG. 1.
Milankovitch's Solar Radiation Curve. (From Zeuner, 1935.)

more than one climax of cold; these are dated from the solar radiation curve as follows:

	Years		Years
Post-glacial	—	Interglacial M/R .	—
Würm 3	18,000	Mindel 2	430,000
Würm 2	67,000	Mindel 1	472,000
Würm 1	112,000	Interglacial G/M .	—
Interglacial R/W .	143,000	Günz 2	545,000
Riss 2	183,000	Günz 1	586,000
Riss 1	286,000		

According to this chronology, *Homo heidelbergensis* flourished about 130,000 years ago, and *H. sapiens* migrated into Europe after the close of Würm 1 about 40,000 years later; palaeolithic culture in Central Europe dates back about 400,000 years; mesolithic appeared after the close of Würm glaciation; and neolithic began 7,500 years ago. In the Near East neolithic culture began earlier.

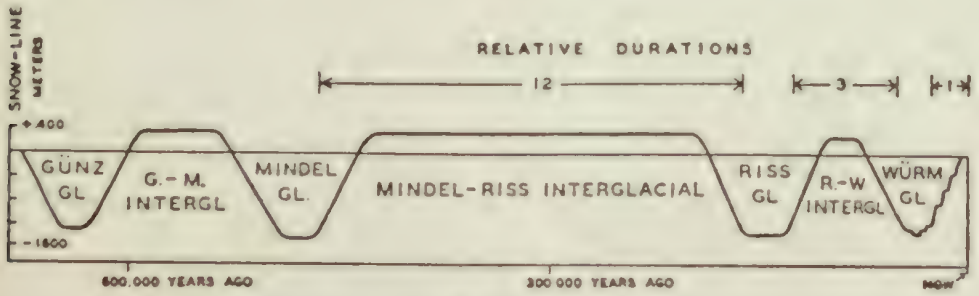

FIG. 2.
Penck and Brückner's Pleistocene Time Dragon.

Penck and Brückner (1909) from purely geological evidence worked out a time scale for Pleistocene stages in the Alps, and their estimates agree in a general way fairly well with the figures given above. Their quantitative graph (Fig. 2) is reproduced from Daly (1934).

Australian Post-Tertiary Geology

Towards the end of the Tertiary period, Australia and Tasmania underwent a tectonic uplift which ushered in the present cycle of erosion. The old Murray Gulf, until then occupied by the sea, was drained; and the Darling, the Murrumbidgee and the Murray, which had previously entered the sea by separate mouths, were engrafted to form a single river system. At a later stage a flat-domed anticline arose across the lower course of the stream; through this the river has cut a gorge 200 ft. deep in places, and for 150 miles between Loxton and Murray Bridge, South Australia, it flows through this canyon (Howchin, 1929). In early Pleistocene times the climate became colder and culminated in successive glacial phases, evidence of which can be seen in Tasmania, at Mount Kosciusko, New South Wales, and in the Owen Stanley Range, New Guinea. Below the snow line the country was well watered during the glacial and possibly the interglacial phases, but then desiccation began and the modern arid climatic cycle in Central Australia was inaugurated. Successive eustatic alternations of high and low sea level gave rise to raised beaches and drowned strandlines. Hodge Smith and Iredale (1924), from geological and biological evidence, concluded that an old shore-line extends along the 70 fathom (420 ft.) submarine contour from Broken Bay, New South Wales, to south-eastern Tasmania. Other strandlines at about 200 ft. and 70 ft. below sea level have been recorded (Cotton, 1926). Similar drowned valleys have been observed in Tasmania (Lewis, 1934, Edwards, 1941). The highest known raised beach, 380 ft. above present sea level, at Ooldea in South Australia, contains fossils which Chapman (1920) regarded as Lower Pleistocene. In the south-east of South Australia a series of dunes, generally consolidated and roughly parallel to the coast, and remains of successive elevated coast lines extend as far as Narracoorte, about 60 miles inland (Tenison Woods, 1862, Howchin, 1918, C. Fenner, 1931, Tindale, 1933, Crocker, 1941). The Narracoorte "Range" follows along a fault scarp which has been revealed by marine denudation in some places and is masked by dunes in others. If the raised strandlines correspond with interglacial high sea levels, and the consolidated dunes were formed during glacial epochs, this district may furnish a key to

Pleistocene history; Hills (1939 b), however, holds that tectonic movements caused the coast to retreat to its present position. In many parts of Australia are remains of a raised beach at about 15-20 ft. above sea level containing mollusca and foraminifera which suggest a climate somewhat warmer than that of the present day (Howchin, 1923, Tindale, 1933). This beach does not appear to correspond with Wright's pre-glacial 15-foot beach of Western Europe, but was probably formed during the slight general post-glacial refrigeration already mentioned; Daly (1934) estimated that the change happened about 4,000 and Cotton (1926) 3,000 to 5,000 years ago, but Milankovitch's curve indicates 10,000 years. River terraces exist at various heights up to 100 ft. above present stream level. Extensive dunes fringe the coast in many places; the older consolidated dunes contain remains of extinct marsupials and in places are covered with volcanic ash, and the youngest dunes are still accumulating. Hills (1939 a) considers that the consolidated dunes were formed during the low-water glacial phases, and that the comparatively minor dunes of loose sand are post-glacial.

Some Australian raised beaches and submerged shore-lines may be due principally or entirely to eustatic changes in sea level; but tectonic movements in certain localities are indicated by such features as the anticline across the lower course of the Murray River (Howchin, 1929), and in north-western Victoria and adjoining areas by elevation during Pleistocene and Holocene times accompanied by faulting and warping (Hills, 1939 b). If we accept as approximately correct Daly's estimate that the melting of all ice-caps and glaciers would raise average sea level about 130 ft., the Ooldea raised beach at 380 ft. above present sea level and about 80 miles from the coast must have been elevated, at least in part, by tectonic movement. The fact that volcanoes were active in south-eastern Australia during Pleistocene and post-Pleistocene times suggests that earth movements were in progress.

The problem of correlating Pleistocene glacial deposits, river terraces, raised beaches, submerged strandlines, sand dunes and alluvial deposits in Australia has not yet been solved. We have no knowledge of the order in which extinct marsupials died out, and consequently their fossil remains do not date the deposits in which they are found; some species and genera possibly did not survive the early Pleistocene stages, but others such as *Diprotodon* appear to have lived until recent times; *Thylacinus* and *Sarcophilus* are extinct on the mainland but survive in Tasmania.

Lewis in 1923 demonstrated three Pleistocene glacial phases in Tasmania and in 1933 he gave a more detailed account of them.

He used local names for identified phases since he was not convinced that they are contemporaneous with Pleistocene glacial phases in the northern hemisphere. He could find no evidence of a fourth phase corresponding to the fourth phase of Europe. The three phases are:

1. The Margaret; the latest, mountain tarn stage.
2. The Yolande; the most obvious, cirque-cutting stage.
3. The Malanna; an ice-cap stage, the oldest and most extensive, but preserved only as fragments.

Lewis considered that his investigations do not preclude other glaciations. There may be (1) an obliterated pre-Malanna glaciation; (2) a glacial phase between the Malanna and the Yolande; or (3) a subdivision of the Malanna into more than one phase.

He said that the Malanna ice-cap covered from a third to a half of Tasmania. It was followed by a lengthy interglacial phase during which he considers that the Pieman, the Derwent and other rivers cut gorges 1,000-2,000 ft. deep in hard rocks. Yolande glaciation moulded the topography of those parts of the island more than 2,000 ft. above sea level and is responsible for the most obvious cirques, moraines and glacial deposits, but it lasted a much shorter time than the Malanna and was less intense. An interglacial phase probably followed; Lewis could not prove this, but considered available evidence pointed to it. The third, least intense and most recent glacial phase is the Margaret, which gave rise to mountain tarns.

Tentative proposals for correlating non-glacial Pleistocene features with glacial phases have been suggested by David (1924), Tindale (1933), Lewis (1934) and Edwards (1941). None of these authors indicates whether heights of raised beaches and terraces were measured by instruments estimated by eye.

David assigned the maximum Tasmanian ice-sheets and the ice-cap of Mount Kosciusko at 5,000 ft. to the Mindel phase, and moraines of the Tasmanian National Park at 2,500-2,800 ft. to the Riss. He considered that erosion of V-shaped valleys superimposed on older U-shaped valleys of the Pieman River, Tasmania, and of the Snowy River at Kosciusko began in the Riss-Würm interglacial phase, and that the extensive rock platform at 65-85 ft. above sea level in the Ringarooma Valley and the peat deposits of Mowbray Swamp, both in Tasmania, were formed at the same period. To Würm glaciation he assigns lake basins in the Tasmanian National Park at 3,200-3,500 ft.; glaciation at Blue Lake, Kosciusko, at 6,150 ft.; and the newest torrent gravels of Eastern Gippsland, Victoria. Minor post-Würm glaciation followed at the

Tasmanian National Park near the 4,000 ft. contour and also gave rise to high-level tarns at Kosciusko and moraines near Townshend's Pass in the same district at 6,400-6,700 ft. This was followed by deglaciation, rising sea level, volcanic eruptions at Mount Gambier, South Australia, and Tower Hill, Victoria, and then by a negative eustatic movement in sea level of about 10-15 ft.

In Tasmania Lewis recognized raised beaches and river terraces at 50-100 ft., 40-50 ft. and 5-15 ft. above sea level, and drowned valleys at 150 ft., 30-60 ft. and 20 ft. below sea level. He tentatively correlates these and other features with the three glaciations. Conglomerates of quartzite pebbles at 50-100 ft. above sea level in southern Tasmania, claypan deposits underlying Mowbray Swamp,[6] and the Helicidae sandstone (consolidated dunes) at 100 ft. on the islands of Bass Strait he regards as pre-Malanman. The channel of the Derwent River is eroded to 150 ft. below sea level and the strandline must have dropped by this amount; he correlated this with eustatic lowering of sea level during Malanna glaciation, when Tasmania and Australia were united by a land-bridge. River terraces and raised beaches at 40-50 ft. he assigns to the Malanna-Yolande interglacial phase; the conglomerates of these terraces in southern Tasmania consist almost entirely of pebbles of dolerite and Permo-Carboniferous mudstone. Vast changes in physiography took place during the Malanna-Yolande interglacial phase. There is some evidence of river erosion 30-60 ft. below sea level which he considers to correspond with the Yolande phase. The formation of the 5-15 ft. raised beaches and the lowest river terraces he correlates with the Yolande-Margaret interglacial phase. The development of existing river courses and a channel 20 ft. below the floor of the Derwent estuary he attributes to the Margaret glacial phase. Since the latest glaciation he considers that there has been a progressive rise in sea level and that the valley of the Derwent has been drowned as far upstream as New Norfolk.

Edwards observed in north-west Tasmania at least two raised shorelines, one at 5-15 ft. and the other at 40-50 ft., with river terraces at corresponding heights and, in the Mersey and Forth valleys, suggestions of a third strandline at about 100 ft. above sea level in the form of doubtful remnants of river terraces; Johnston (1888) had noted a raised beach at this level on Chappell Island. The valley of the Tamar can be clearly followed on the Admiralty Chart to 15 fathoms and less clearly to 20 fathoms, and contours of submarine valleys in the neighbourhood of Hunter Island and Three Hummocks Island can be traced to 25 fathoms,

6. For notes on Mowbray Swamp see Noetling (1911).

indicating a submerged shoreline at 120-150 ft. Many basalt-filled valleys pass below sea level and there is some geological evidence that they are older than the 120-150 ft. submerged strandline, but no depth can be suggested for the corresponding submerged shore. He considered that in view of the magnitude of eustatic changes in sea level, there can be little doubt that successive glacial and interglacial stages are contemporaneous throughout the world, and that Tasmanian river terraces and strandlines must be correlated with those of the northern hemisphere. There is considerable evidence for a world-wide eustatic fall in sea level of about 15-20 ft. in post-glacial times and we should therefore expect four sets of terraces, but in Tasmania, where the record is not complete, only three have been demonstrated. In his opinion the 40-50 ft. raised strandline may correspond to the Riss-Würm interglacial stage, and the 100-150 ft. strandline to the Mindel-Riss stage; according to figures given by Daly (1934) for corresponding raised beaches in Europe and North Africa, their heights are of about the right magnitude. The 120-150 ft. submerged strandline is older than the 40-50 ft. raised beach and presumably younger than the 100-150 ft. raised beach, and on the suggested correlation it should correspond to the Riss glacial stage. The pre-basaltic strandline should be correlated with an earlier glacial stage, possibly the Günz, but he points out that the basalt-filled valleys may have been brought to their present positions by faulting.

David's, Lewis's, and Edward's tentative correlations of Australian Pleistocene and Holocene phenomena are tabulated on the adjacent page.

Tindale (1933) recorded six raised strandlines between Narracoorte, South Australia, and the present coast. They are situated at heights ranging from about 15 ft. to 220 ft. above sea level on the seaward side of parallel lines of dunes. He correlated them with six raised beaches on the Atlantic coast of the United States investigated by Cooke (1930). Below are tabulated Tindale's and Cooke's names for the South Australian and American terraces, Cooke's tentative correlation with glacial and interglacial phases (American nomenclature), and the equivalent European periods according to Daly (1934):

S.A. Strands	U.S.A. Strands	Glacial and Interglacial Phases	
Woakwine	Pamlico	Mid-Wisconsin	Mid-Würm
Reedy Creek	Chowan	Peorian	Riss-Würm Intergl.
West Avenue	Wiscomico	Sangamon	Riss-Würm Intergl.
East Avenue	Sunderland	Yarmouth	Mindel-Riss Intergl.
Cave Range	Coharie	Aftonian	Günz-Mindel Intergl.
Narracoorte	Brandywine	Pre-glacial	Pre-glacial

	David, 1924	Lewis, 1933, 1934	Edwards, 1941
Post-Glacial . . .	Progressive fall in sea level. 10-15 ft. raised beach. Eruptions at Tower Hill and Mt. Gambier. Deglaciation with rising sea level.	Progressive rise in sea level.	5-15 ft. raised beaches and terraces.
Würm Glaciation (Margaret) . .	Last severe glaciation. Lake basins, National Park, Tasmania, and Mt. Kosciusko.	Margaret glaciation. River channel 20 ft. below floor of Derwent estuary.	
Riss-Würm Interglacial (Yolande-Margaret) . . .	V-shaped superimposed on U-shaped valleys of Pieman and Snowy Rivers. Ringarooma flats excavated. Mowbray Swamp peat deposits.	5-15 ft. raised beaches. Lowest river terraces.	40-50 ft. raised beaches.
Riss Glaciation (Yolande) . . .	Moraines, National Park.	Yolande glaciation. River erosion probably to 60 ft. below sea level.	120-150 ft. submerged strandline.
Mindel-Riss Interglacial (Malanna-Yolande) . . .		Raised beaches at 40-50 ft. River terraces at corresponding heights. Gorges cut 1000-1200 ft. deep.	100-150 ft. raised beaches.
Mindel Glaciation (Malanna) . . .	Maximum ice-sheets, Tasmania. "Calotte" ice, Mt. Kosciusko. Kosciusko-Snowy River moraines.	Malanna glaciation. River erosion to 150 ft. below sea level.	
Günz-Mindel Interglacial			

	David, 1924	Lewis, 1933, 1934	Edwards, 1941
Günz Glaciation .		? Malanna glaciation in part.	? Submerged basalt-filled valleys.
Pre-Glacial		Gravels at 50-100 ft. Helicidae sandstone at 100 ft. Claypan deposits underlying Mowbray Swamp.	

Contour maps prepared by Noetling (1909) from soundings recorded on Admiralty charts show that a lowering of sea level by 25 fathoms (150 ft.) would almost connect Tasmania and Australia by land, and a fall of 30 fathoms (180 ft.) would complete the land-bridge.[7] Lewis (1934) correlates the greatest fall in sea level that he found in Tasmania, about 150 ft., with the Malanna glacial phase, and Edwards (1941) with the Yolande. If either of these opinions is correct, and there have been no appreciable tectonic movements, island and mainland have been separated by sea since the second or third Pleistocene glacial epoch, a period antedating the migration of *Homo sapiens* into Europe.

The fauna of Tasmania and adjacent islands in Bass Strait differs from that of the Australian mainland in several respects, suggesting that the two regions have been isolated from each other long enough for evolutionary changes to have taken place. The Tasmanian region is small and its topography and climate resemble those of the adjacent mainland, particularly Gippsland. Differences in fauna may be illustrated by birds and mammals. Tasmania has about 200 species of birds, most of them in common with Australia, of which about one-fourth are passerine, a ratio of 1 to 3 in contrast to a ratio of 1 to 1 on the mainland. Of nine good species confined to the Tasmanian region, two are restricted to Tasmania proper and seven are also found on adjacent islands. In addition, many well-defined subspecies are peculiar to this region. Tasmania has 32 species of land mammals; two monotremes (Platypus and Echidna), 20 marsupials, and 10 placentals (rats and bats). The Echidna is a subspecies confined to Tasmania and adjacent islands. Twelve of the marsupials are found also in Australia, but eight good species and three subspecies are restricted to the Tasmanian region; of these, four species are found only in Tasmania, and four species and three subspecies also inhabit adjacent islands. *Macropus billardieri*, one of the

7. For supplementary soundings see Dannevig (1910).

species now confined to the Tasmanian region, became extinct on the Australian mainland only 70 years ago; and bones of two others, *Thylacinus cyanocephalus* and *Sarcophilus ursinus*, are found in Holocene deposits on the mainland (Mahony, 1912, Hale and Tindale, 1928). Among the placentals, two rats are confined to Tasmania, the others being also found in Australia. For the above details of birds and mammals I am indebted to George Mack and C. W. Brazenor respectively. The fact that the fauna of islands in Bass Strait is essentially Tasmanian indicates that these islands continued to be connected by land with Tasmania long after the Tasmanian region and the Australian mainland were separated by sea.[8]

Geological Evidence of Human Antiquity in Australia

Fossil or sub-fossil human bones have been found in a few Australian localities. Those from Talgai, Aitape, and Keilor are very probably of Pleistocene age: geological evidence of the age of the Keilor skulls and bones seems irrefutable. There are insufficient data on which to base even a guess at the age of the Tartanga bones, except that they are much younger than the Pleistocene anticline through which the Murray in this locality has cut its canyon, but considerably older than those found in the adjacent Devon Downs rock shelter. Evidence concerning the identification and age of the alleged human tooth from the Wellington Caves bone-breccia is unsatisfactory. The Devon Downs bones and the mineralized skulls found at Cohuna and elsewhere in the Murray valley are geologically recent though probably ancient in the historical sense.

Many claims for antiquity of man in Australia have been based on artefacts found, or alleged to have been found, in consolidated dunes, beneath lavas or tuffs of the Newer Volcanic period, in beds containing bones of extinct marsupials, associated with raised shorelines, or buried beneath alluvium. The Newer Volcanic eruptions probably began in Pliocene or early Pleistocene times and continued after the Pleistocene period came to an end, and we know nothing about the order in which various extinct mar-

8. For further details of Australian Post-Tertiary geology see W. Anderson (1890 a), Andrews (1902), Aurousseau and Budge (1921), Bryan (1925), Cameron (1901), Campbell (1910), Chapman (1928), Chapman and Gabriel (1918), Chapman and Mawson (1925), David (1907, 1932), David and Etheridge (1890 b), Dennant (1887), Etheridge (1876, 1890), Etheridge and others (1896), Grant and Thiele (1902), Gregory (1861), Hall (1909), Hardman (1883, 1884, 1885), Harper (1916), Hart (1893), Hills (1940 a, b), Howchin (1887, 1912, 1918, 1923), Hunter (1909), Jack and Etheridge (1892), Jackson (1902), Johnston (1888), Jutson and Coulson (1936), Keble and Macpherson (1943), Kitson (1900, 1902), Lucas (1887), Marshall and others (1925), Murray (1887), Pritchard (1910), Richards and Hedley (1925), Singleton (1941), Saint-Smith (1912), Selwyn (1854), Somerville (1920), von Sommer (1849), Süssmilch (1922), Whitehouse (1940), Woods (1862), Woodward (1894), and Woolnough (1912).

supials died out or when they became extinct; unless there is corroborative evidence, mere association with volcanic rocks or with strata containing bones of extinct marsupials does not prove that artefacts are of Pleistocene age, but geological evidence strongly suggests that the Myrniong artefacts belong to this period. Some shell middens are associated with inland shorelines about 10 ft. or 20 ft. above present sea level, which are probably about 4,000 years old; if this estimate is correct, and the middens were formed not long before sea level fell, these middens are ancient in the historical, but not in the geological sense, and the men who made them lived at about the time that Abraham went into the land of Canaan; it is possible, however, that these shorelines are more than 4,000 years old. In some localities deposition of alluvium is still in progress, in others it has long ceased; evidence for antiquity of bones and artefacts covered by alluvium therefore depends on local conditions.

The Wellington Tooth Fragment

Since some confusion exists concerning this specimen, its full history is given below.

The first to observe bone-breccias in the Wellington caves appears to have been George Rankin, of Bathurst, New South Wales, in 1830; later in that year Major Thomas Mitchell visited the caves and collected fossil bones, which he sent to Sir Richard Owen. Mitchell (1838) published an account of the caves with plans and a list of fossil marsupials collected there and determined by Owen.

Krefft (1867, p. 91) wrote: "*Homo*, Melanian variety. Bones of the extremities found in a cave at Wellington Valley, being—left and right femur, left and right tibia, left and right humerus, portion of fibula"; he makes no suggestion that the bones were ancient or fossilized. On p. 112 he says that in one of the Wellington caves "human remains were obtained, but though very old they are not fossil."

The history of the exploration of the caves between 1867 and 1882 is set out in a New South Wales Parliamentary Paper (Anonymous, 1882). At the suggestion of Sir Richard Owen, the New South Wales Parliament in 1867 voted funds for the exploration of the caves by the Curator of the Australian Museum, at that time Gerard Krefft. In October, 1869, Krefft reported that he had sunk two shafts in the bone-breccia and had obtained many fossil bones, including those of *Thylacoleo, Diprotodon, Nototherium,* and *Canis dingo*; he also gave a "List of photographs of Australian fossils for transmission to Professor Owen, F.R.S.,"

in which, under Plate II, he mentions "the 5th metatarsal bone of a man (recent)." Owen, in a letter to Krefft, dated January 8th, 1870, remarked: "... the only disappointment was the absence of human remains and works; but this is an instructive negative fact and accords well with former experience of research in the Wellington Caves." Krefft's more detailed list of fossils, dated May, 1870, makes no mention of human bones or teeth. In a geological report made in the same year, Professor A. M. Thomson, who visited the site with Krefft, said that "in the caves at Wellington no vestiges of man, whether in the shape of bones, weapons or works of art, have been discovered."

In another publication, not recorded in the Parliamentary Paper, Krefft (1870) referred to the fractured crown of a molar tooth, probably human, found in the Wellington caves, and four years later (Krefft, 1874) he wrote: "I have found the fractured crown of a human molar tooth in the same matrix as *Diprotodon* and *Thylacoleo* at Wellington in this colony. Man may therefore have been the contemporary of these animals and also of *Dromornis*." These are apparently Krefft's only published references to the tooth. None is given in the Parliamentary Paper of 1882. Krefft's appointment at the Australian Museum was terminated in August, 1874.

Etheridge (1891) re-examined the fragment, which consists of about two-thirds of the crown broken off from the remainder of the tooth, and wrote—"that it is the crown of a human molar is, I think, beyond much doubt; but to guard against mistake I placed the specimen in the hands of Mr. P. R. Pedley,[9] who corroborates Mr. Krefft's determination." The tooth, though mineralized to the same extent as the marsupial teeth, was not in the matrix, and Etheridge was not convinced that it came from the bone-breccia. He mentioned a recent unmineralized skeleton of an aboriginal woman found in No. 2 cave; this is possibly the "human remains" recorded by Krefft in 1867. Later, Etheridge (1916) found among the Krefft MSS. in the Mitchell Library in Krefft's own handwriting an explanation of the plates that had been published in the Parliamentary Paper referred to above. In explanation of Plate 12, Krefft wrote: "Figs. 3 and 4. Side view, natural size, and view from above enlarged of a human molar tooth, taken from the solid breccia of Wellington Cave by the writer." Attached to these documents is what appears to be a small plan of the work going on at the caves under Krefft's supervision, but possibly prepared by the workman in charge, giving depths and details; in a footnote to this plan occurs the following remark: "In a

9. Pedley was then a leading dentist in Sydney.

well-hole where Krefft found human skeleton in red breccia." This skeleton, as far as I can ascertain, had never before been mentioned in any publication, and Dr. Walkom, Director of the Australian Museum, has informed me that no record of it can be found in the Australian Museum.

C. Anderson (1926) considered that the fossil bones of the bone-breccia are those of animals which either fell through sink holes or were swept in by flood waters; that they probably differ considerably in age; and that the human tooth, therefore, may possibly belong to a later period than some of the other bones.

Finally, Dr. T. D. Campbell has kindly allowed me to say that in 1935 he had an opportunity of briefly examining the specimen, and in notes made at that time he recorded that the attrition of the tooth fragment does not appear to accord with that usually found on aboriginal molars; and this appearance, together with other features, left in his mind a definite doubt that the tooth fragment is human.

Both geological evidence of antiquity and specific determination of the tooth are unsatisfactory.

The specimen is in the Australian Museum, Sydney.

The Talgai Skull.

The Talgai skull was found in 1884 by a man employed at Talgai Station, near Clifton, Darling Downs, Queensland, and was in private possession until 1914, when it was forwarded to Professor Edgeworth David. Shortly afterwards, David and Wilson (1914) published a preliminary note on the skull. Stewart Smith (1918), who described it in detail, says that late in 1914 Professor David visited Talgai and there found the original discoverer, then a very old man, who pointed out to within a few yards the spot in the bank of the gully where he had found the skull 30 years previously. He said that it protruded from the bank about 3 ft. above the bottom of the gully. Here black soil 6 or 7 ft. thick overlies red-brown clay, and according to the finder, the skull was embedded in the upper part of the clay. No bones of extinct marsupials have been found at this site, but they have been found in similar clay at various places in the Darling Downs, such as King's Creek, 10 miles from Talgai. David supplied Stewart Smith with geological notes and the section reproduced in Fig. 3.

The skull is that of a male youth with unerupted wisdom teeth. It is mineralized and has been considerably distorted by pressure of the clay in which it was embedded.

Geological evidence cannot be regarded as satisfactory since it depends on the memory of an untrained observer who found the

specimen 30 years before he pointed out the site to David; but colour, state of mineralization, and distortion of the skull are similar to those characteristic of skulls of extinct marsupials found in the red-brown clay of the Darling Downs. Whether this formation is Pleistocene or Holocene in age has not been determined, but it is probably Pleistocene.

According to Stewart Smith the skull is very primitive,

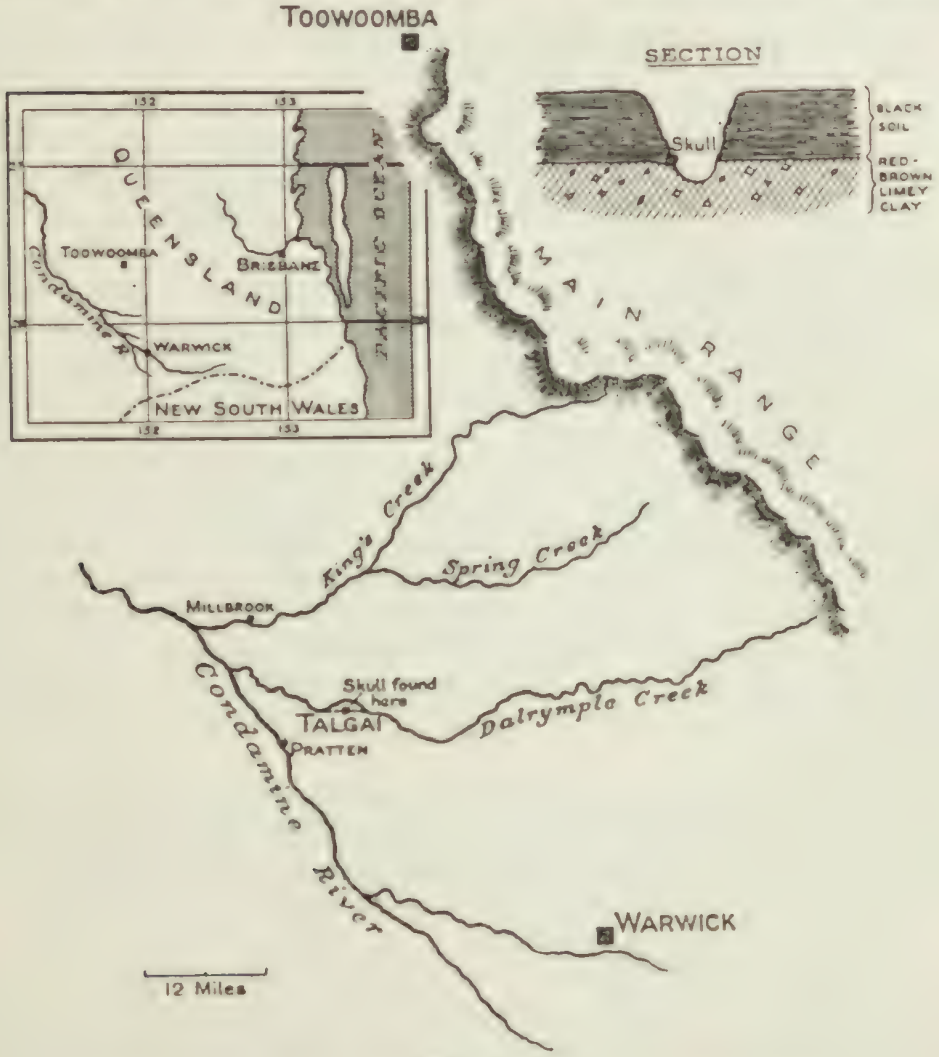

FIG 3.
Talgai: Locality Plan and Geological Section. (Stewart Smith, 1918.)

especially in respect to the large facetted canine teeth, but it is undoubtedly of the Australian type, and available evidence fails to reveal Tasmanian affinities. He said that the cranium is similar in all respects to the cranium of the modern Australian, and the facial skeleton is of Australian type; but in the palate and canine

teeth there are, in conjunction with the most primitive characters found in modern skulls, others more ape-like than have been observed in any living or extinct race, except *Eoanthropus*. Burkitt (1928) concluded that the position and facetting of the canine teeth fall into line with those of modern aboriginals, but that the teeth anterior to the molars are more primitive, especially in size; and that Stewart Smith's conclusions regarding the primitive character of the palate remain unaltered. He said that the palate of the Talgai skull with unerupted wisdom teeth is as large as the palate of the average modern adult male aboriginal with the full complement of molar teeth.

Campbell (1925) remarked that measurements of the teeth of the Talgai youth are greater than average measurements of corresponding teeth of modern aboriginals, but, with few exceptions, all lie within the extreme range.

Wood Jones (1934 a) published dioptrographic drawings of the palates of a large modern aboriginal skull from Wentworth, New South Wales, and of the Talgai skull. He says that the teeth of the Wentworth skull are worn and the canines are absent, but even with this disadvantage it clearly demonstrates the fact that the Talgai skull has no real claims to be considered outside the range of variation of the recent aboriginal. He adds that since Stewart Smith's original publication, investigations by Campbell and Burkitt have rightly tended to diminish the importance of certain features taken by Stewart Smith to indicate a peculiarly ape-like dentition; and that it is fair to say that the Talgai skull should be regarded as that of a young aboriginal with large palate and large teeth, but still not wholly outlandish even in regard to these features.

Dr. J. Wunderly has informed me that some canine teeth extracted in the Melbourne Dental Hospital from jaws of Europeans are larger than any recorded for Australian aboriginals.

The skull is in the Anatomy School, University of Sydney.

The Tartanga Skeletons

Tartanga lies in the Murray River canyon near Nildottie, South Australia, where the valley is a mile wide and is bounded by cliffs of Tertiary limestone about 40 ft. high. The river is over 100 yards across and the narrow low-lying island where the bones were found separates the stream from Tartanga lagoon.

Part of a human skeleton exposed by erosion at Tartanga was sent to the South Australian Museum in 1928 by W. R. Roy, of New Devon Downs. In consequence, Hale and Tindale (1928) excavated both this site and the adjacent Devon Downs rock

shelter with great care. Palates and teeth of human skulls they discovered were examined by Dr. T. D. Campbell.

Hale and Tindale cut a trench across the outcrops of five layers of consolidated sand and clay having a total thickness of about 6 ft. 6 in.; these beds dip eastwards at a low angle, and they are overlain to the east by recent unconsolidated mud and silt. The first-found fossil skeleton was exposed by denudation in the uppermost consolidated layer. These and other human bones found at this site are heavily stained with iron oxide and considerably mineralized.

In the top layer was the much fragmented skeleton of a child with a fairly complete skull, of which the authors give measurements and dioptrographic drawings. Dimensions of all teeth except the unerupted third molars are greater than the average recorded for Australian aborigines, the second incisor being equal to the maximum, but, as in the Talgai skull, the upper third molars are of less than average size. The estimated area of the palate is 3,600 sq. mm., a size found only in exceptionally large Australian adult male skulls, but the teeth suggest a child 10-12 years old. The body had apparently been buried from the upper part of the bed in which it was found. In the next underlying bed were portions of a left maxilla, the right ramus of a lower jaw and three loose teeth. The teeth, which indicate a child about 12 years old, are large, and crenulation of the occlusal surface of the second and third molars is more marked than is usual in teeth of modern Australian aborigines. In the third bed from the surface were the greater part of the bones of the trunk and a skull fragment; this was a burial, apparently from the upper part of the uppermost bed.

With the bones was evidence of occupation of the site—burnt stones, food debris, flakes of quartz and chert, and implements of chert and bone. Shells of a freshwater mussel are abundant; the shell is relatively thicker than that of *Unio rittatus*, which lives in the neighbouring lagoon, but otherwise resembles it, and Hale and Tindale gave this mussel specific rank with the name *Unio* (*Hyridella*) *provittatus*.

The authors conclude that full discussion of the Tartanga remains must await detailed study; that material at present available suggests an early Australian race linking Talgai man with modern aborigines; and that geological and physiographic features indicate at least some antiquity.

Tindale (1941) suggested that the Tartangan may have resembled the Tasmanian aboriginal, but he brought forward no evidence to support this view; he adds that Tartangan man

seemingly lived immediately prior to the formation of the post-glacial (12-20 ft.) marine terrace.

The bones were in a deposit formed after the river had cut its canyon through the Pleistocene anticline previously mentioned.

All specimens are in the South Australian Museum, Adelaide.

Devon Downs Human Remains.

At Devon Downs cliff shelter, occupational detritus, where excavated by Hale and Tindale (1928), was about 20 ft. thick and divided into twelve layers. The shelter had previously been described and figured, but not excavated, by H. L. Sheard (1927).

Human remains were found in the second, third, fourth, sixth, and eleventh layers from the surface. None was mineralized. In layer 2 were the bones of a young baby; a burial. In layer 3 a child of 15 to 18 months old had been buried; the skull was almost complete, and most of the other bones were recovered; deciduous teeth are all present and are very large. From layer 4 a deep grave penetrated layer 5 and part of layer 6; it contained a child's skeleton and an almost complete human lower jaw; the teeth are similar to those from layer 3. In layer 6 were the greater part of a lower jaw, some teeth, and a few fragments of the calvarium of a child about 5 years of age; the jaw and teeth resemble those of recent young aborigines of similar age. In layer 11 was a single, much-worn crown of a left deciduous incisor; it is large but considerably worn by attrition.

Hundreds of artefacts and animal remains were distributed throughout the occupational detritus. Bones of *Sarcophilus,* now confined to Tasmania, occur in the lower layers.

The authors believe that the accumulations in Devon Downs shelter are younger than the Tartangan strata; that the artefacts in successive layers of the well-stratified occupational detritus indicate five successive cultural phases; and that faunal modifications are possibly due to changes in climate.

The thickness of stratified detritus and variation in artefacts and fauna in successive layers indicate that the shelter was used by aborigines for many centuries.

All specimens are in the South Australian Museum, Adelaide.

The Keilor Skulls and Bones.

Two mineralized human skulls and some other bones were found in undisturbed ground at a depth of 19 ft. in a terrace adjoining the Maribyrnong River and 45 ft. above river level. The sandpit where they were found is a mile north of Keilor village, which lies 10 miles north-west of Melbourne. The sandpit was worked by

R. Hughes, sand contractor. Except for two small pieces of bone near the foramen magnum and a hole in the side made by the pick of the workman who unearthed it, one skull is complete, but its lower jaw is missing. It is large and it combines Australoid with Tasmanoid characteristics in about equal proportions. Anatomical descriptions of the specimen as a whole by Dr. J. Wunderly and of the palate and dental arch by Dr. William Adam will be found elsewhere in this volume of Memoirs, together with notes based on geological investigations by R. A. Keble and Miss Hope Macpherson, which indicate that it dates back to the Riss-Würm Inter-

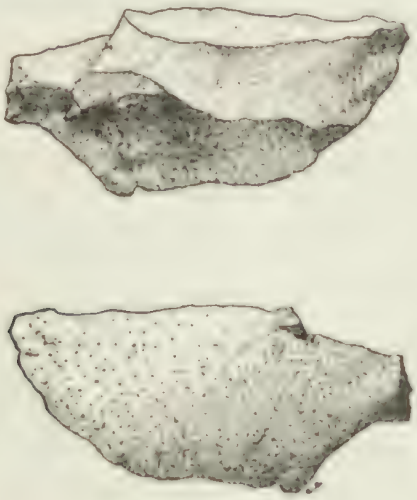

FIG. 4.
Quartzite Flake, Keilor.

glacial phase of Pleistocene times. The second skull and most of the other bones have not yet been received by the Museum.

Mr. Hughes has supplied the following note on the circumstances of the discovery:

"Early in October (about Oct. 10th), 1940, a fossil human skull was found by James White, who was employed by me, in a pit which I opened for moulding sand near the junction of Dry Creek and the Maribyrnong River about one mile north of Keilor. I was present at the time together with Thomas Murphy. White was working on the face of the pit when his pick went through the skull and broke it into three pieces. It was about 15 ft. below the surface of the ground and 18 in. above the floor of the pit. One fossilized limb bone and several other fragments of bone were found alongside the skull. The sand above the bones showed no signs of having been disturbed by a burial and the skull could not have fallen from above since it was embedded in undisturbed sand. We washed off the sand with which it was coated. I took the skull and pieces of broken bone to the National Museum on November 4th, 1940, and left them there. Some weeks later Mr. Mahony, Mr. Keble and Mr. Brazenor of the National Museum visited the sand pit with me and I pointed out to them the spot where the skull was found. Up

to this time the face of the pit at this point was in the same condition as when the skull was found. Since then five pieces of another skull were found at the same level and about six feet distant from the first skull."

(Signed) R. Hughes, Aug. 22nd, 1942

Dr. E. S. Hills found a quartzite flake protruding from undisturbed sand in the wall of the pit close to the spot where the skull was unearthed. The flake (Fig. 4) is evidently an artefact.

Owing to war-time conditions it has been impossible to carry out systematic excavation and sieving of sand to find other bones, teeth and artefacts.

One skull, some fragments of bone and the quartzite flake are in the National Museum of Victoria, Melbourne.

The Aitape Skull

This specimen is mentioned since New Guinea is close to Australia, the skull is Australian in type, and there is geological evidence of its antiquity. It was described by F. J. Fenner (1941).

Aitape District is situated in the western part of the Mandated Territory of New Guinea. In 1929, P. S. Hossfeld, of the Northern Australian Geological Survey, found fragments of a fossil human skull *in situ* in a bed of littoral marine clay outcropping in the east bank of Paniri Creek near Barida Village, Aitape, 10 miles from the coast and about 300 ft. above sea level. The skull was overlain by 4 ft. of undisturbed littoral deposit containing marine mollusca, and above this by 6 ft. of gravel on which rested soil. The littoral marine deposit forms part of the Upper Wanimo Series which is considered by Survey authorities to be Pleistocene in age. There is no record of other mammalian bones at this site.

The fragment was broken into four pieces while being unearthed. Three of these fitted together accurately. The reconstructed calvarium comprises the greater part of the frontal bone, parts absent being the left external angular processes and both orbital plates. The nasal process is almost entire, and the sutural impressions of the nasal bones and the nasal processes of the maxilla are preserved. On the right side, the sutural impression of the frontal process of the zygomatic bone is undamaged. Portions of both parietal bones are present, their broken edges running roughly parallel to the coronal suture and about three centimetres behind it. The specimen shows no evidence of being waterworn. Fenner suggests that the fragment is portion of the skull of a female about 45 years of age. He discusses its racial affinities and considers that it belonged to an individual not differing greatly from the southern type of modern Australian aboriginal, but he adds that occasional rare Australoid types of New Guinea skull

differ from the Aitape fragment little more than do average Australian skulls. There are no characters suggesting affinities with Tasmanians; the absence of the paramedian parietal groove, stressed by Wunderly as characteristic of Tasmanians, and the fairly obvious narrowness of the parietal region definitely excluding this possibility.

The skull is in the Australian Institute of Anatomy, Canberra.

Other Fossil Human Remains

Basedow (1925) mentioned the fossilized posterior half of the left parietal of a human skull found in "Pleistocene (or Pliocene?)" gravels SSE. of Tennant's Creek district, Central Australia. He gives no exact locality, no indication of how the age of the deposit was determined, nor at what depth the specimen was found, nor who discovered it. I can find no record of where the specimen now is. H. M. Hale and N. B. Tindale, of the South Australian Museum, have informed me that they handled the specimen some years ago, and that Basedow then told them that it had been found on the surface; it was stained brown but not mineralized, and in their opinion it did not suggest geological antiquity. After Basedow's death they prepared his collections for submission to the Institute of Anatomy, Canberra, which afterwards purchased them, but the specimen was not then recognized among his effects.

The Melbourne *Argus* of December 6th, 1915, published the following note:

"While digging out marl at Jimmy's Point, Lakes Entrance, a labourer recently unearthed three human skulls, evidently of very primitive type. They were near the base of the escarpment, and about ten feet from the grassed surface. Each of them was in a remarkably good state of preservation. Professor Flynn from Tasmania, who was making an official tour of inquiry at the Lakes with the Chief Inspector of Fisheries, Victoria, examined the skulls, and said he would report to the Melbourne University, and that they were of great archaeological interest."

I have been unable to find what became of these skulls; they are not at the Melbourne University.

Under favourable conditions, such as contact with water carrying carbonates in solution, organic matter may be rapidly mineralized. There are certain springs in which twigs, etc., become coated and impregnated with carbonate of lime in a few weeks. Mineralization of human bones cannot therefore be taken as proof of geological antiquity; the age of the deposit in which the bones are found and evidence that they are contemporaneous with it, not subsequent burials, are the only acceptable proofs of geological antiquity.

However, since mineralization of bones predisposes some people to attribute geological antiquity to them, Australian examples with no claim to such antiquity are mentioned below.

In the surface deposits of the vast alluvial plain through which the Murray, its anabranches and tributaries wander, mineralized human skulls and other bones have been found at or close to the surface at Renmark, Swan Hill, Cohuna, Moulamein, Nyang, Balranald, Euston, and Nacurrie. Alluvium has here accumulated to a depth of at least 150 ft. during Post-Tertiary times, and all surface deposits are Holocene.

Except in the case of the Cohuna skull, no claim has been made that these skulls differ from those of modern Australian aborigines. Wood Jones, who examined some of them, is of the opinion that there are no morphological features by which they can be differentiated from those of modern aborigines (Wood Jones, 1934; Mahony and others, 1936). F. J. Fenner (1938) described two of them (a child of 4 or 5 years old and an adult), both pathologic, together with three similarly pathologic skulls of recent aborigines, and he found that in features other than pathologic the adult skull is typical of the adult male Australian.

The Cohuna skull, however, has had some fame to which, as shown below, it is not entitled. It was found during the excavation of an irrigation channel near Cohuna, Victoria, in November, 1925, at a depth of two feet in red loam. No other human bones were discovered at this place, but normal aboriginal skeletons were unearthed close by at about the same depth. George Terry of Cohuna brought the skull under notice. A geological report on the site made by the writer of this paper in March, 1926, recorded that there is no evidence of geological antiquity; the report was published some years later (Mahony and others, 1936). Dr. W. R. Browne has informed me that he agrees with this opinion after examining the site in 1940 in company with Professors Priestly, Burkitt and Shellshear. The skull was acquired by Sir Colin Mackenzie, Director of the Australian Institute of Anatomy, who did not describe it but sent some data, with measurements and a tracing along the middle line of the skull, to Sir Arthur Keith. Keith (1931) published an account based on this information, and expressed the opinion that it is the most primitive known type of human skull. The error arose from the fact that Mackenzie mistook for bone the adhering mineral incrustation, which is up to a quarter of an inch thick in places; for this information I am indebted to Professor A. N. Burkitt. Professor J. L. Shellshear has kindly allowed me to say that, after Sir Colin Mackenzie's death, he removed the incrustation, and that from his observations

on the skull he finds that it falls within the range of modern aboriginal skulls, to which it is similar in all respects. Campbell (1943) says that the intact, major portion of the Cohuna dental arch is typical of a large aboriginal dental arch.

Shellshear (1939) described a partly mineralized normal aboriginal skull found on the beach of Stradbroke Island, Queensland.

The flexed, desiccated body of an aboriginal partly encrusted with stalagmite was was found in one of the Mosquito Plain caves near Mount Gambier, South Australia (Woods, 1862). It was exhibited in a number of towns in Australia and Tasmania as a "Petrified Woman," and is reported to be now in a Berlin museum. It was probably a recent burial similar to that described by Tindale and Mountford (1936). Other records of recent human remains found in caves are given by Etheridge (1893) and by Etheridge and Trickett (1905); as a rule aborigines fear dark caves and do not enter them.

Artefacts

At the Doone tin mine in north-eastern Tasmania, stanniferous sands and gravels were treated by sluicing the sides of an open cut with a powerful jet of water. A stone implement was found in material brought down by sluicing, and David (1923) claimed that it is contemporaneous with the stanniferous sands which he believed to be Pleistocene in age and of fluvio-glacial origin. The writer of this paper examined the implement soon afterwards and noticed that one side was more weathered than the other, which suggested that it had long lain on the surface of the ground and had then fallen into the open cut. Meston (1936) gave reasons for believing that it had fallen from the surface and that it is of recent origin.

In the Derwent Valley, Tasmania, is a midden which Lewis (1934) correlated with the Yolande-Margaret (Riss-Würm) interglacial phase, but Meston has shown that it is almost certainly modern.

Consolidated calcareous dunes in the Warrnambool district, Victoria, extend along the coast and are overlain in places by bedded tuff ejected from Tower Hill. These dunes may have been formed during one of the Pleistocene glacial phases (Hills, 1938 a). The dune rock was formerly quarried for building purposes, and some of the slabs bore impressions of footprints of large struthious birds. In 1890 a slab quarried at a depth of 50 ft. displayed impressions supposed to resemble human footprints and also marks such as would be made by two people sitting side by side on soft sand (Officer, 1892). The specimen is in the

Warrnambool Museum, but the stone is friable and the impressions are almost obliterated; photographs taken while they were distinct were published by Branco (1905) and by Klaatsch (1906). Gregory (1904) rejected as man-made both tracks and other impressions. The tracks are narrow and are identical in shape with those made in snow by kangaroos (Noetling, 1907). There can be little doubt that the tracks and other impressions were made by kangaroos, not by human beings.

About 45 years ago C. C. Brittlebank, Government Plant Pathologist, while making geological observations, found a stone implement in a bed of gravelly clay 1 ft. 6 in. thick resting on Permo-Carboniferous glacial strata and underlying Newer Volcanic lava flows near the junction of Myrniong Creek and the Werribee River, about six miles north-west of Bacchus Marsh,

FIG. 5.
Site where the first sub-basaltic Artefact was found (X).
Sketch from a photograph by C. C. Brittlebank.

Victoria (Plate I). He presented the specimen to the National Museum, but did not publish any record of it. The implement is a wedge-shaped slab of hard slaty rock measuring about 7 inches by 6 inches, the narrowest part (4 inches) being at the thicker end. One face, somewhat roughened by weathering, is slightly concave, and near its centre are indentations made by pounding with another stone; the opposite face is slightly convex, rougher, and shows no signs of usage. Flakes have been struck off the edges of one side and of the thinner end, as if to make a crude chopper.

The other side is straight and smooth, apparently a natural cleavage surface, and the smaller end is bounded by two fractures. Weathering has dulled sharp edges. A few years later Brittlebank found two more artefacts in the same sub-basaltic gravel; one of these is the axe illustrated in Plate III, figs. 3 and 4. One-third of this axe protruded from the outcrop and the rest was embedded in tough sandy red clay which had to be picked away to free it. The other specimen, though less deeply embedded, was also firmly fixed in the clay. Both were found within a few yards of where the first was discovered. His letters to the Museum record that Brittlebank found the first artefact in an excavation made for the purpose of observing the effect produced by heat from the lava on the underlying gravelly clay. At about 1 ft. 8 in. or 2 ft. from the outcrop of this bed he found the implement in tough gravelly clay and almost in contact with the base of the lava flow. Since it differed in shape and size from the surrounding quartz pebbles, he examined it closely and, observing the chipped edge, he took it to water and washed away the adhering red sandy clay and small pebbles. He then saw that it was an implement made of hard slate. He was convinced that it could not have fallen through a fracture in the basalt to the position where he found it, nor have been placed there in post-basaltic times. Brittlebank being an experienced and accurate scientific observer and a sound geologist, his evidence must carry great weight. It has been suggested that the first-found implement may have been buried in recent times by surface material sliding down the slope of the hill (Mahony and others, 1933), but these authors did not know that Brittlebank found two other artefacts in the same gravel. Since the basalt was extruded, valleys several hundred feet deep have been cut through it into the underlying rocks, and the basalt where the artefact was found forms a small isolated plateau, locally known as The Island, since it is almost surrounded by the deep valleys of the Werribee River and Myrniong Creek. The area is close to the eastern margin of the Ballarat Plateau. The Island is about 1,200 ft. above sea level, and the adjoining Bacchus Marsh basin, through which the Werribee River flows, is nearly 900 ft. lower and is only 5 miles distant as the crow flies. Brittlebank made a geological map and section of the locality and marked on it the site where he found the first sub-basaltic implement (Plate II): his manuscript map is in the National Museum of Victoria.

The Werribee River is a puny stream. At Bacchus Marsh its drainage area is 115 sq. miles and its average discharge 250 gallons of water per second; in summer it usually ceases to flow. Between

Ballan and the Bacchus Marsh basin, a distance of eight miles as the crow flies or eleven along the course of the river, its bed falls 95 ft. per mile[10] and the river flows through a gorge ranging from 400 ft. to 600 ft. in depth. Possibly in its early development, when the stream was cutting its valley into the Newer Volcanic lava, it flowed over a waterfall into the Bacchus Marsh basin, and owing to erosion the ledge over which it fell retreated upstream and finally disappeared, leaving a steeply inclined river bed. Rainfall may formerly have been greater than it is now.

For a period of five years Brittlebank (1900) conducted experiments at numerous points to determine the rate of erosion of the bed of the gorge, and his results work out at 0·58 inch per century. The period of experiment was probably too short and his methods not sufficiently accurate to give a figure other than an approximation to the right order of magnitude. No data are available for similar streams elsewhere. The average rate of degradation of the Mississippi basin is estimated at 0·34 inch per century, and Niagara Falls are retreating upstream at an average rate of 4 ft. 6 in. per annum (Chamberlin and Salisbury, 1905), but the general fall per mile of the Mississippi is low and the rate of retreat of Niagara Falls is exceptionally rapid, so these figures are of little value in an enquiry into the rate of formation of the Werribee gorge, but they indicate that a waterfall causes rapid erosion.

If we assume that the rate of erosion of Werribee gorge during its whole development was very high and averaged 20 times the amount that Brittlebank's figure indicates for the present time, say 12 inches per century, the excavation of the gorge would take 60,000 years. Though this figure is hypothetical and probably too small, it indicates that the sub-basaltic gravel bed at Myrniong in which the implements were found is Pleistocene in age.

In the Great Buninyong Estate mine, near Ballarat, Victoria, fragments of bones of extinct marsupials were found 240 ft. from the surface in black pyritic clay underlying a basaltic lava flow; the bones were near the base of the lava. The clay is a swamp deposit and the basalt is a lava flow from Mount Buninyong, a scoria cone in the vicinity (Hart, 1899). The bones, which are mineralized and impregnated with pyrites, were identified by De Vis (1899) as those of *Diprotodon* and an extinct kangaroo, *Macropus faunus*. One fragment, probably part of a *Diprotodon* rib, is about 6 inches long, irregular at one end and terminated at the other by two cuts from opposite sides which do not meet

10. Figures for drainage area, discharge and fall of river bed were supplied by the Victorian State Rivers and Water Supply Commission: river gaugings at Bacchus Marsh were taken over a period of 15 years.

but are separated by an irregular broken surface (Plate III, figs. 5 and 6). The cuts were considered by De Vis to have been made by a sharp implement, not by teeth of carnivores, and in his opinion the specimen is an artefact. Gregory (1904) rejected this suggestion, and held that the cuts were made accidentally by the shovel of the miner who unearthed the bone. The surface of each cut, however, is not flat as would be expected if made with a shovel; one, especially, looks like the result of several short strokes of a pocket knife used as in cutting plug tobacco. Possibly the miner who found it tested its hardness in this way. The shape of the fragment and the relative positions of the cuts do not suggest an artefact. A. S. Kenyon, who examined the specimen at about the same time as Gregory, recorded that the cuts had crushed the pyrites in the bone, and were therefore made after the bone had been fossilized (Mahony and others, 1933). Many years ago the specimen was covered with size to prevent oxidation of the pyrites; no pyrites can now be seen and it is therefore difficult to determine the appearance of the cuts when the bone was found. A face cut for experimental purposes in 1934 on one of the other Buninyong bones has exactly the same appearance as those on the supposed artefact. De Vis identified one of the other fragments as probably the head of the same rib from which supposed artefact was made; if this is correct, it seems more reasonable to suppose that the bone was broken by the jaws of a carnivore than that a man would make an implement out of one part of the rib and then discard it close to the rejected portion. The specimen was formerly in the Ballarat School of Mines but is now in the National Museum of Victoria, Melbourne.

Cuts and scratches on bones of extinct marsupials from the Darling Downs, Queensland, and several localities in Victoria, considered by some observers to have been made by human agency, have been attributed to tooth marks of the marsupial lion, *Thylacoleo*, by De Vis (1884) and by Spencer and Walcott (1912). J. E. Tenison Woods (1883, 1886) noticed scars on the bone of a large struthious bird associated with midden material near Penola, South Australia, and suggested that they were made by aborigines; he considered that the bird is the extinct *Dromornis*.[11]

A small quartzite upper mill stone (Plate III, figs. 1 and 2) was found in 1908 by A. J. Merry of Terang while making an excavation for the foundations of a concrete culvert over Pejark Swamp drainage channel where it crosses the road from Terang to Noorat, Victoria. One side has been rubbed flat, and a depression ("husking hole") has been made on the other (Plate III, figs. 5 and 6);

11. See also Etheridge (1890).

similar implements are commonly found on the surface in Victoria. He gave the specimen to the National Museum and supplied the following information. The excavation, which is 10 ft. deep, passed through soil 3 ft., bedded volcanic tuff 2 ft., black clay 3 ft., and yellow clay 2 ft. The yellow clay and the base of the black clay contained numerous fragments of marsupial bones. The millstone was embedded in the yellow clay 2 ft. below the level of the bed of the drainage channel and 3 ft. distant from it. Merry, while digging in the yellow clay, felt his shovel strike against a solid object and, thinking it might be a large fragment of bone, he dug it out carefully. Shortly afterwards he showed it to Dr. Beaton, a local medical practitioner, and after the adhering yellow clay had been washed off, both of them recognized it as a stone implement. Merry found another stone implement in clay thrown out of the excavation, but could not be certain which part of the hole it came from. He added that R. Harvie, who had been employed in excavating the drainage channel in 1893, told him that he had dug up a grindstone from similar yellow clay 4 ft. below the bedded tuff layer at a site about one chain west of the culvert, and that a petrified human skull had also been found 5 ft. below the tuff about 100 yards west of the culvert, but the skull was broken up and thrown away by the workman who found it. Sir Baldwin Spencer and R. H. Walcott, in December, 1908, made excavations alongside the drainage channel near the culvert but found nothing except fragments of marsupial bones. Spencer and Walcott (1911) recorded the implement without giving full details since their paper concerned scars and scratches on fossil marsupial bones from this and other localities. Further excavations should be made at this site.

Stone implements are said to have been found under tuff near Mount Schank, South Australia, but no particulars are available.

In 1854 a basalt axe-head was found by A. C. Swinton at a depth of 4 ft. in alluvial wash in which he was sinking a shaft that bottomed on bedrock at 5 ft. (Howitt, 1898); the wash was cemented gravel with three false bottoms and was situated in a small tributary valley of the main lead near Maryborough, Victoria. About 40 years later, Swinton, at the request of Howitt, marked on a plan the position of this shaft, and Stanley Hunter, an officer of the Geological Survey, examined the locality. Hunter found that the tributary referred to by Swinton is one of the heads of the Bet Bet sub-basaltic lead (buried river valley) and he considered that the lower deposits of wash in the tributary may be of the same age as the sub-basaltic wash of the Bet Bet lead. At a later date Hunter told Gregory that he did not attach much

importance to the discovery of the artefact since it might have fallen into a wombat hole or a natural hollow in the ground (Gregory, 1904); it seems unlikely, however, that wombats would burrow in consolidated gravel or that prospectors would sink a shaft where there was a natural hollow.

In Dicker's *Mining Record*, 1864, p. 120, a figure is given of a basalt axe-like implement with a hafting groove found in undisturbed gravelly clay at 22 inches below the surface at Ballarat. It was 8 inches long, weighed 5 lb., and was patinated. The implement (fig. 6) is similar to a type commonly found on the surface in the Western District of Victoria.

Voisey (1934) recorded kitchen middens of oyster and other shells along the base of low cliffs that mark an old coast line extending from Grassy Head to Collombatti, about 10 miles inland, in the Kempsey district, New South Wales. The old strandline

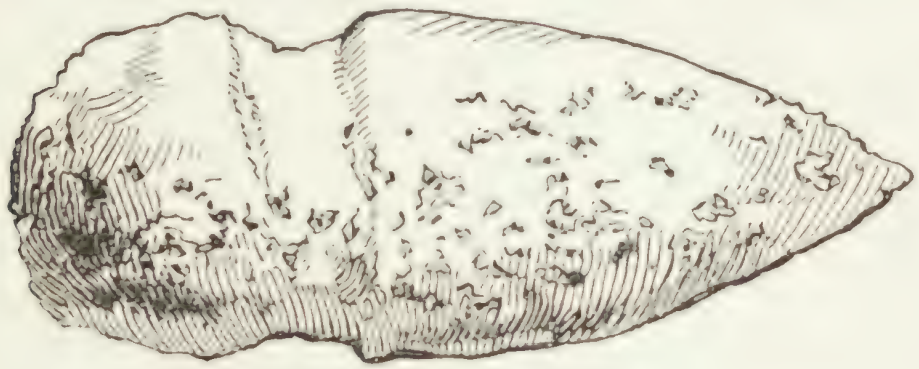

FIG. 6.
The Ballarat Implement.
(Reproduced from Dicker's *Mining Record*, 1864.)

is about 10 ft. above present high-tide level. McCarthy (1943), who described these middens and the contained implements, quotes Professor L. A. Cotton's opinion that they were formed between 5,000 and 11,000 years ago. Near the mouth of the Burdekin River, Queensland, is another locality where oyster-shell middens containing stone artefacts are associated with an old shoreline 4 miles inland and about 20 ft. above high-tide level (Jardine, 1928). Since primitive people do not carry large quantities of shellfish to camps several miles inland, the inference is that these middens were formed before the sea retreated to the present shoreline. W. Anderson (1890 b) made a similar suggestion in regard to middens 30 ft. above sea level near Pambula and Noorooma, N.S.W.

South of the Embley River on the western side of Cape York Peninsula and about three-quarters of a mile inland from the coast

there are large shell middens forming a series of heaps and mounds from 20 to 30 ft. high which extend for several hundred yards (Jackson, 1902).

Middens several acres in extent and up to 10 ft. thick composed of oyster and other shells have long been known in Tasmania. Noetling (1910) calculated that the time required for them to accumulate is 5,000 to 7,000 years. His calculations are based on assumptions, which may or may not be approximately correct, concerning the number of natives formerly inhabiting Tasmania, and shellfish consumed per head per day. David (1923) thought that a considerably longer time is indicated.

At the Reedbeds, Fulham, near Adelaide (White, 1919; Howchin, 1919), and at Shea's Creek, near Sydney (Etheridge and others, 1896), artefacts have been found near the coast in swamp deposits or estuarine beds a few feet below sea level.[12] Both deposits are considered to be geologically recent.

The only records of implements in river terraces are those of Ferguson (1894), who found some in terraces a little above the level of the present streams in the valleys of the Hopkins and Wannon Rivers, near Wickliff, Victoria, and the artefact found near the Keilor skulls.

Large areas of Central Australia are covered with "gibber," that is, with wind-worn fragments of hard rock derived from strata disintegrated by subaerial denudation. Among the gibber stones Howchin (1921) found flaked pieces of siliceous rock with patinated surfaces; he regarded them as ancient artefacts of an earlier cultural phase than that of modern aborigines. Wood Jones and Campbell (1925) and Tindale (1932) have furnished sound reasons for believing that the flaking was fortuitously caused by natural agencies.

Bennett (1867) recorded that sandstone with grooves similar to those made on grindstones or outcrops of sandstone by aborigines when sharpening their stone axes was found in the Hunter River valley, New South Wales, under 30 ft. or more of alluvium. In this locality alluvium accumulates rapidly and instances are cited of some flats having been buried under 4 ft. of silt during a single flood (MacPherson, 1886).

During the construction in 1913 of the Sugarloaf Dam near the junction of the Goulburn and Delatite Rivers, R. B. Comer, engineer, State Rivers and Water Supply Commission, collected hundreds of stone implements for the National Museum of Victoria. Among them was an axe fashioned from a pebble found more than 20 ft. below the surface, and four others from 28 ft.;

12. See also David (1923 a) and Tindale (1937 b).

the latter came from an excavation at the head of a gully near Mount Tinnigar, Devil's River.

At Hasemer's brick pit, Forbes, New South Wales, Andrews (1901) recorded middens and bones of *Diprotodon* in alluvium at a depth of 18 ft. from the surface. There is no available evidence as to whether alluvium is now accumulating at this site. Andrews has informed me that he saw the pit only after complete removal of these objects, but that he considers that Hasemer's statement concerning them was an honest one; he cannot, however, vouch for the association of the midden with the bones.

A stone tomahawk was unearthed at a depth of 2 ft. in 1870 by miners digging a water-race in shingly alluvium at the side of the valley of the Upper Dargo River, Victoria (Howitt, 1898). Howitt, who visited the locality soon afterwards, did not consider that there is evidence of geological antiquity.

Wilkinson (1887) recorded a stone axe found at 14 ft. below the surface at Bodalla, near the coast of New South Wales, about 80 miles north of the boundary of Victoria.

At West Maitland, New South Wales, a primitive stone axe with a ground edge was found in ferruginous clay at 11 ft. below the surface during the sinking of a mine shaft (Enright, 1923). Immediately below the surface is a bed of reddish clay 8 ft. thick and below this is ferruginous clay 7 ft. 6 in. thick in which the specimen was found. Surface topography suggests that the clay beds were not recently deposited.

Near Cape Otway, Victoria, artefacts were recorded in a mixture of beach material, pebbles, humus and broken shells resting on Permo-Carboniferous sandstone and apparently intermediate between it and dunes 200 ft. high (Etheridge, 1876). David and Etheridge (1890) considered that the deposit, since it underlies a dune of this size, must be ancient, but Gregory (1904) held that the implements were buried by the advancing dune, or that the shelly material was a surface layer resting on the dune and extending beyond its edge.

Certain rock carvings in the Flinders Range, South Australia, are patinated, and Basedow (1914) claimed that they are ancient. The evidence has been discussed by Mountford (1929 a), who thought that some of the carvings are of considerable age, and by Ward and others (1933), who do not believe that any claim to antiquity can be substantiated.

Mountford (1926 b) described a rock-carving from Panaramitte, South Australia, which he believes depicts the head of a crocodile, a reptile long extinct in South Australia and now represented there only by fossils.

Typography of certain stone implements found in Australia may furnish evidence of antiquity. Crude flint implements deeply patinated are fairly abundant in the south-east corner of South Australia, and McCarthy (1940) holds that both typography and patination indicate their antiquity, and he compares them with products of the Hoabinhien cultural phase of the Far East. Tindale (1937 a) considered that Tasmanian implements show typological evolution and that certain artefacts found on Kangaroo Island and elsewhere in South Australia are primitive and ancient. Hale and Tindale (1928) recorded six successive cultural stages in implements found at Tartanga and Devon Downs, South Australia. Throughout Australia are found implements the uses of which are apparently unknown to modern aborigines; among them are microliths which recall those of Azilian age in Europe resembling small Gravette points and Chatelperron points (Casey, 1934, 1936; Campbell and Noone, 1943).

Australian aborigines use both highly specialized and very crude stone implements and even unflaked stones with natural sharp edges (Mountford, 1940). In basing inferences on typography, this fact must be borne in mind. Little is known about length of time required for patination to occur, but it evidently varies both with rock type and with atmospheric conditions; deep patination therefore cannot always be assumed to indicate antiquity.

Summary

Evidence set out above indicates that mankind migrated into Australia at a period that is certainly ancient in the historical and almost certainly in the geological sense, as is shown by the geological investigations of R. A. Keble and Miss Hope Macpherson and by the Myrniong implements.

The evidence also strongly suggests that the earliest migrants belonged to a Tasmanoid (Negrito) race that had no domestic dog, and that this race occupied the mainland and found its way to Tasmania. At a later date came a wave of Australoid (Dravidian) immigrants with their domestic dog, the dingo; on the mainland they dispossessed the Tasmanoids and absorbed some part of them, but they did not cross Bass Strait to Tasmania, except in small numbers during modern times.

Tasmanian and Australian, especially West Australian, skulls have certain characteristics in common. Anatomical studies of the Keilor skull by Dr. J. Wunderly and Dr. Wm. Adam indicate that this arises from racial intermixture rather than from close kinship between the original Tasmanoid and Australoid races.

Acknowledgments

To Professors J. L. Shellshear and A. N. Burkitt, Drs. J. Wunderly, W. R. Browne, A. B. Edwards and T. D. Campbell and Messrs. H. M. Hale and the late A. S. Kenyon, I am indebted for reading the first rough draft of this paper and for offering suggestions that have been embodied in its final form; to W. Baragwanath, Director of Geological Survey, for having the map and section (Plate I) redrawn by A. E. Kennedy; to C. W. Brazenor for photographs used in Plate II; and to L. A. Baillôt of the Melbourne Technical College for photographs used in Plate III.

Appendix

In a scrapbook purchased by the Melbourne Public Library in 1889 is an engraving (Fig. 7) of a human head carved in wood and accompanying manuscript notes which are quoted below. The carving is said to have been found 60 feet below the surface at Creswick in 1851. It is evidently the specimen mentioned by Smythe (1869, p. 150), who considered it a forgery; he said that an engraving of it, together with letters and documents testifying to its authenticity, had been

FIG. 7.
The Creswick Carving.

published. The artist S.T.G. is doubtless S. T. Gill, a number of whose sketches of scenes in Victoria, including three of Creswick, were published in 1855 by J. J. Blundell & Co., to whom F. J. Bury's letter (see below) is addressed.

The craftsmanship is unlike that of primitive man either ancient or modern, and the features are European in appearance. In my opinion no claim for its antiquity can be taken seriously. Perhaps, as a practical joke, the head was carved by one of the miners from a piece of semi-fossil wood and buried at a spot where Smith and his friends would find it.

I have been unable to discover if the carving still exists or where the woodcut and documents relating to it were published.

The manuscript notes are as follows:

COPY OF DECLARATION.

True Copy (W.S.).

We, James Smith, Robert Tapley, and John Mackie, do solemnly and sincerely declare, that the Carving of the Human Head, now produced, was found by us on Wednesday, the 21st day of February, 1855, in a Hole on the Black Lead, Creswick, at a depth of 60 feet 6 inches from the surface. The Head was found at the bottom of a drift, which drift formed a superstratum to the clay. The Head is at present in precisely the same state as when found by us.

And we make this solemn Declaration conscientiously believing the same to be true, and by virtue of the provisions of an Act, made and passed in the 9th Year of the Reign of Her present Majesty, intituled, An Act for the more effectual abolition of Oaths and Affirmations taken and made in various departments of the Government of New South Wales, and to Substitute Declarations in lieu thereof, and for the suppression of voluntary and extra judicial Oaths and Affidavits.

(Signed) James Smith, Robert Tapley, John Mackie.

Made and signed before us at Creswick, this 24th day of March, 1855,
(Signed) F. J. Bury, J.P., Bernard Smith, J.P., James Green Taylor, J.P.

EXTRACTS FROM LETTERS FROM THOMAS BURR, ESQ., DISTRICT SURVEYOR.

I was present at the time this affirmation was made, and have cogent reasons for believing that this is no imposition, from the circumstance of having, in connexion with mineralogy, for many years been accustomed to study the fracture of different substances, it has led me to examine minutely the surface of any matter put into my hands; and the entire surface of this Head presents a homogeneous appearance, which indicates that, at whatever time it was carved, the whole was done at the same time, and that the mass had been exposed to the same circumstances subsequently, except one or two small abrasures, which were evidently recent, and were known to have been made since the time that this specimen was brought to the surface. The wood appears to be the root of one of the Eucalyptus tribe, but the substance has been so changed either by heat, or by pressure, or these combined, as to be converted into Graphite.

It may be as well to observe, that, in connexion with the Carved Head here shown, there was a large quantity of Wood, similarly altered in appearance or substance. This Wood belongs to Genera and Species identical with that at present growing in this part of the Continent of New Holland, namely, Eucalyptus, Casuarinae and Banksia; the cones of the latter, more especially, being met with in profusion, and beautifully preserved.

(Signed) Thomas Burr.

Ballarat 29th Sepr. 1855.

F. J. Bury to J. J. Blundell & Co.

Gentlemen.—In reply to your letter of the 20th instant, on the subject of the Carving in Wood found at Creswick on the 21st February last.—I beg to state that the carving in question was brought to me by James Smith and party within a few hours after its discovery and remained for some time in my possession. The strata in which the carving was found was Black Clay, and the ground was first opened and worked by Smith's party; in the same hole, and in several adjacent ones, large portions of Wood and honeysuckle cones were, at various times, found at depths varying from fifty to eighty feet.

The Declaration, subsequently signed before me, was made in consequence of reports having been circulated that the carving had been executed by Smith's party.

I am, Gentlemen,
Your most obedient servant,
(Signed) F. J. Bury.

To Messrs. J. J. Blundell & Co., Melbourne.

Explanation of Plates

Plate I.

The Keilor skull before removal of incrustation.

Plate II.

C. C. Brittlebank's geological map and section of the area near the junction of Myrniong Creek with the Werribee River where he found stone implements in sub-basaltic river gravel. Heights are shown relative to his house, "Dunbar," which is about 1200 ft. above sea level.

Plate III.

Figs. 1 and 2. The Pejark implement. Top and base.
Figs. 3 and 4. One of the Myrniong implements: a crude axe or chopper made by flaking both sides of one end of a flat quartzite pebble. Aspect from each side.
Figs. 5 and 6. The Buninyong bone. Aspect from each side.

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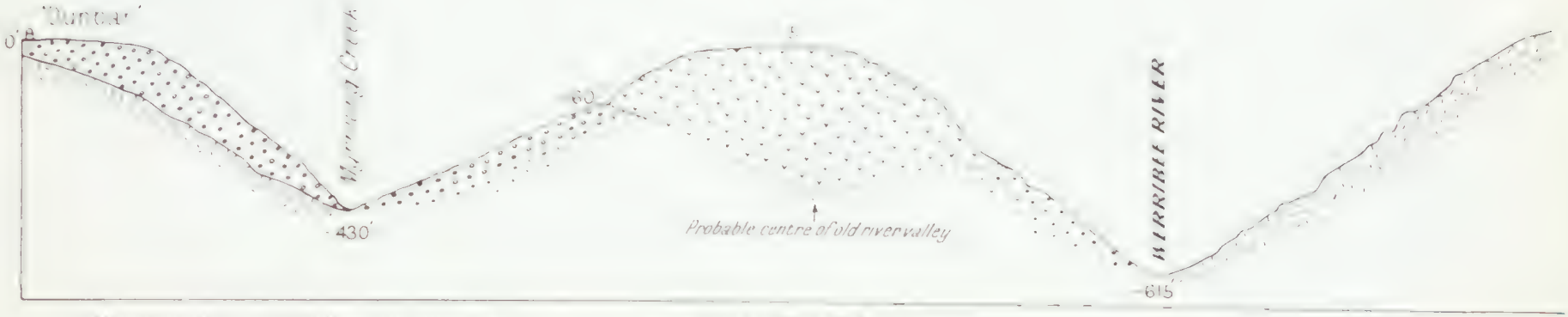
— PLAN —

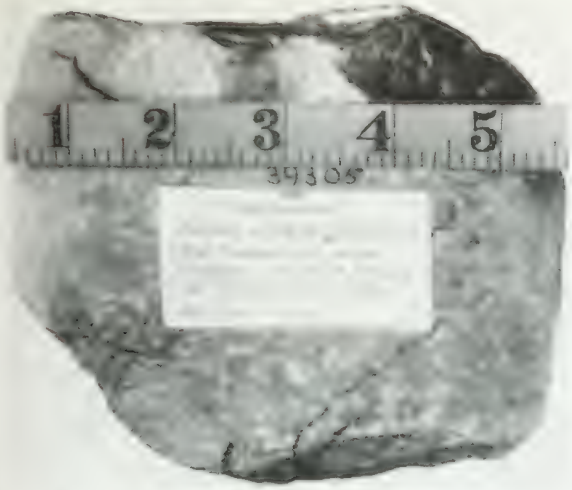
SCALE 40 Chains to one inch



Horizontal scale, 6 inches to one mile

— SECTION —

Vertical scale, 400 feet to one inch



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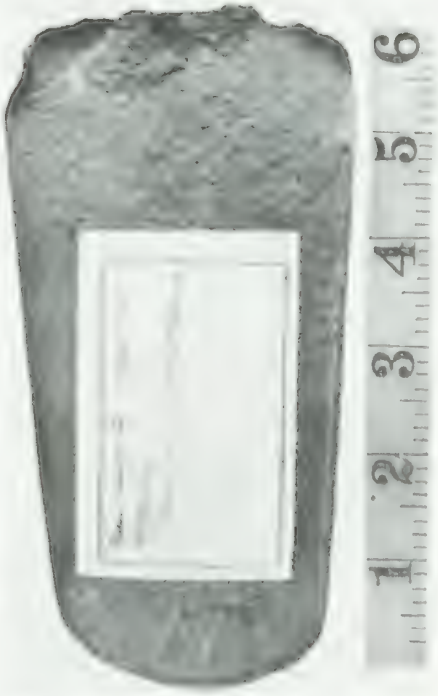

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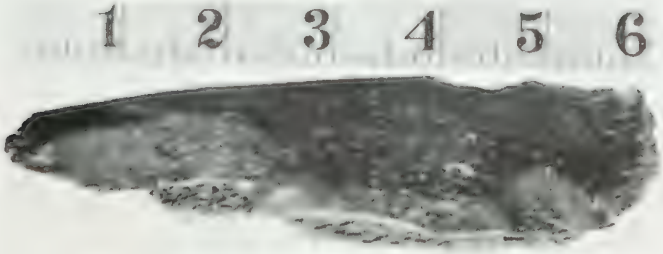

6

THE KEILOR FOSSIL SKULL: ANATOMICAL DESCRIPTION

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Plates IV-IX

The Keilor skull, when found, was almost completely covered with a mineral incrustation, the greater part of which has since been removed from the outer surface. The mandible and a part of each zygomatic arch, of the right temporal bone, and of the occipital bone, are missing. The skull was unearthed by a workman whose pick penetrated the cranium and shattered a piece of the right parietal bone measuring about 35 x 27 mm. The bone of the skull is mineralized and is very firm.

Photographs were taken after the removal of the incrustation (Pl. IV-VI). Contour drawings have been made (Pl. VII-IX) and measurements are shown in Tables I and II in comparison with corresponding data for series of Australian, Tasmanian, Melanesian, and Polynesian male skulls. All figures in these tables, except those for the Keilor skull and Tasmanian skulls, are quoted from Wagner (10); figures for Tasmanians are from Wunderly (11) and Morant (6). In both tables two columns of figures are shown under each heading except that referring to the Keilor skull; the first are measurements and the second show the number of specimens measured.

Orbitale, both poria, basion, and opisthion are all present. The difficulty in locating the prosthion, to which Wagner and others have alluded, is somewhat reduced in the Keilor skull, because some of the alveolar bone in this region has been lost through post-mortem damage, leaving a fairly sharp point of bone, which is the only one that can be used for measurements. Visual examination suggests that about 2 mm. of the alveolar bone has been lost, but the measurements have been made from the existing point of bone. All measurements from the alveolar point and prosthion are therefore approximate. A suitable point for measuring the bizygomatic breadth is available on the right side; on the left side, however, a point was used on a line joining the lateral edges of the broken anterior and posterior ends of the arch; this measurement is estimated to be between 1 and 2 mm. less than the correct value.

The means in Table I were not all calculated from measurements

made according to the biometric technique of Buxton and Morant (3). Those used by Morant (6) were calculated from measurements made by other authors. The symbols in the table are those used by Morant and other authors of papers published in *Biometrika*, with two additional symbols, Z_1, Z_2. Wunderly's (11) figures for the orbital breadth of the Tasmanians apply to the dacryal orbital breadth.

The inferior border of each nasal bone is missing. The maximum width of the nasal bones, measured at their existing lower borders, is 16·5 mm. Their width at the fronto-nasal suture is 19 mm. As the lateral margins of the pyriform aperture exhibit the positions to which the nasal bones originally extended, their maximum width has been measured on these margins; it is 20 mm.

All linear measurements are in millimetres.

Anatomical Characteristics

The skull is long, but it is not high or wide relative to its length. The surface of the bone is generally smooth. The areas of muscle attachment are not as rough as in many Australian skulls.

The median curvature of the frontal bone is as broad as that found in the majority of the skulls of Australian and Tasmanian males. The superciliary and supra-orbital ridges are moderately prominent, but the nasion is not deeply depressed.

The parietal eminences are not as prominent as they are in many Tasmanian skulls, but they are more noticeable than in the majority of Australian crania. The Keilor skull exhibits occipital protuberance to an extent that is unusual in the skulls of males of the Oceanic races, except the Tasmanian.

The cranial sutures are not complicated. The metopic suture is patent throughout almost its whole length. Parts of the coronal and the metopic sutures are fused outwardly. The posterior one-third of the sagittal suture lies in a slight depression.

The orbits are distinctly rectangular and their transverse axes are inclined upwards at their median ends more than in some Tasmanian, but less than in the majority of Australian skulls. In the upper margin of the right orbit there is a notch about 3 mm. wide, and in that of the left orbit a shallow groove about 5 mm. wide.

The margins of the narial aperture are not so broadly rounded as in many Tasmanian and Australian skulls. On the right the inferior margin is single and well defined, while on the left it is double and it has fairly sharp edges. The nasal bones are typically Australian, and they lack the extreme restriction and convexity seen in many Tasmanian specimens.

The canine fossae are deep. The facial part of the skull exhibits, in addition to the Tasmanoid characters that have been referred to, several others which are described elsewhere in this volume by Dr. Wm. Adam.

The Keilor skull has none of the extreme features that are seen in many Australian male crania, such as the acute keeling of the vault, the very rough areas of muscle attachment, and the general ruggedness of bone construction.

On account of the incrustation on the inner aspect of the cranium, it was not possible to measure the cranial capacity in the usual way. Lee's formula No. 10 was, therefore, used in calculating it. This formula is as follows:

·000365 (Length × Breadth × Auricular Height) + 359·34.

Anatomically, the skull exhibits a mixture of Australoid and Tasmanoid characteristics in about equal proportions. In general form it resembles the cranial type of the South Australian males, but the parietal eminences and the superciliary ridges are more prominent than is usual in them.

Cranial Contour Drawings

Contour drawings of the Keilor skull are shown in Pl. VII, VIII and IX.

Type contours were obtained from four male Tasmanian skulls in the Anatomy School, University of Melbourne; war-time conditions prevent access to a larger series. Since the number of specimens is small, mean measurements for Tasmanian type contours in Table II are not as accurate as mean values for various racial groups quoted from Wagner (10, Table 27).

The irregularity in the line and the asymmetry on the right side of the transverse, vertical and horizontal contours of the Keilor skull are due to damage caused at the time of discovery.

Sagittal Contour (Pl. VII).

The sagittal contour was drawn while the skull was orientated at right angles to the Frankfurt horizontal plane, and not as described by Bennington (1) and Wagner (10).

The points marked on the drawings are those used by Wagner and are as follows: nasion, N; gamma, γ, in the same horizontal plane as nasion, when the skull is orientated in the Frankfurt plane; glabella, G; bregma, B; vertex, V; lambda, λ; inion, I; basion, BA; opisthion, OP; porion, AUR; orbitale, SUB. ORB; and alveolar point, AP.

Fifty-seven measurements of the sagittal contour of the Keilor skull are recorded in Table II together with Wagner's mean

measurements for skulls of males of a number of racial groups. The Keilor skull excels all groups in sixteen of these measurements; less than half the groups exceed the Keilor skull in twenty-one of the remaining measurements.

The sagittal contour of the Keilor skull closely resembles the corresponding contour of South Australian male crania figured by Wagner (10, fig. 25, Pl. III), and by Fenner (4, fig. 5, p. 258).

Approximately 50 per cent. of the measurements of the Keilor skull exceed those of all groups except three.

Horizontal Contour (Pl. VIII)

The horizontal contour was drawn through the glabella while the skull was orientated in the Frankfurt plane. The points marked on the drawing are as follows: glabella, F; occipital point, O, as far as possible in the median sagittal plane; and the points on each side where the contour cuts the temporal lines, TR and TL.

Twenty-nine measurements are shown in Table II together with the measurements of Wagner's contours for males of several racial groups. In seventeen measurements, those of the Keilor skull exceed those of all these racial groups.

Transverse Contour (Pl. IX)

The transverse contour was drawn through the poria while the skull was orientated at right angles to the Frankfurt plane. The points marked on the drawing are as follows: the points at which the contour cuts the sharp ridge on the crista zygomatica, ZR and ZL; the mid-point, M, of the base line; and the point A, where the vertical from M meets the contour. The ends of the contour line represent the poria on the skull.

Twenty-nine measurements of this contour are included in Table II together with those of the corresponding contour of racial groups. In sixteen measurements the Keilor transverse contour exceeds those of the corresponding contours of all the groups. Only the Sandwich Island group exceeds the Keilor skull in the length of the vertical axis.

Cranial Measurements

(a) *Absolute Measurements*

Table I gives measurements of the Keilor skull and mean measurements of crania of various Oceanic groups; figures for the Oceanic groups are quoted from Wagner (10, Table 23), except those for Tasmanians, which are from Wunderly (11) and Morant (6). This table shows that the Keilor skull is comparatively large. In seventeen of the twenty-eight measurements it exceeds the mean measurements of all groups shown in the table. Over 60 per

cent. of the measurements of the Keilor skull are greater than the mean measurements of all the racial groups recorded in Table I.

Hrdlička (5) measured nearly 1,000 Australian skulls. The following table shows that three of the more important measurements of the Keilor skull are comparable with the maxima recorded by Hrdlička, for the corresponding measurements of skulls of males of six Australian regional groups:

Group	Max. Glabella Length	Max. Parietal Breadth	Basion-Bregmatic Height
Northern Territory	206	139	147
Queensland	199	142	150
New South Wales	204	141	147
West Australia	194	140	138
South Australia	216	146	143
Victoria	208	143	147
Keilor Skull	197	143	143

(b) *Cranial Indices.*

Six indices have been recorded for the Keilor skull.

The following table compares these indices with corresponding indices for eight racial groups, data for which are quoted from Wagner (10), Wunderly (11), and Morant (6):

	Breadth-Length	Height-Length	Height-Breadth	Foramen Magnum	Orbital	Nasal
Keilor	72·6	72·1	100·0	82·1	75·9	54·0
Total Australia	70·1	71·8	102·4	84·6	76·2	54·0
Tasmania—A*	74·2	70·6	93·9	81·6	78·2	59·9
B*	74·2	71·3	96·3	82·1	—	59·1
Melanesia	71·7	74·1	104·2	84·2	79·4	53·4
New Guinea	72·0	73·3	102·1	81·5	82·0	51·6
Maori	73·7	74·1	100·7	88·8	82·1	47·9
Marquesan	76·7	74·2	97·0	86·7	81·9	44·4
Sandwich Islands	78·5	77·5	98·8	87·7	81·0	49·0

*A from Wunderly (11) and B from Morant (6).

In respect of four of the six indices, the values for the Keilor skull occupy the middle third of the total range of nine racial values, while, in the remaining two indices, they lie in the lowest third.

Summary and Conclusions

The foregoing notes reveal the following particulars about the Keilor skull:

1. It combines Australoid and Tasmanoid characteristics in about equal proportions.

2. Compared with the average male skulls of several Oceanic races, it is large.
3. The form of its contour resembles closely that of the South Australian male skull.
4. The anatomical characteristics, absolute measurements, and contour drawings indicate masculinity.
5. The cranial sutures and other features indicate an individual of middle age.
6. The Australoid and Tasmanoid anatomical characteristics are consistent with the theory that the Australians had a bi-racial origin, and also with the supplementary theory that Australia was originally peopled by Negritos. The presence of characteristics of the two racial types is more important than their proportional relationship.

The theory of remote bi-racial origin of the Australians is independent of recent admixture with races, which are known to have entered Australia in the north and the north-east in comparatively recent times; this admixture is still going on.

The characteristics of the Keilor skull are also consistent with the geological evidence, which is given elsewhere in this volume, that it is of some geological antiquity.

Technique of Examination

In the examination of the Keilor skull, the English biometric technique described in several papers published in *Biometrika* (1, 3, and 8) has been followed with a few modifications suggested by Wagner (10) and by Wunderly (11).

Orientation.

The skull was orientated in the Frankfurt horizontal plane. The apparatus used for supporting it is a modification of Martin's Kubuskraniophor. Several years ago the adjustable clamp of the kubus was found to cause considerable damage to fragile skulls; the clamp was therefore removed and various parts were added, as shown in fig. 1.

Two vertical bars, A and B, have been fixed to each side of the kubus frame, and each carries an attachment that is adjustable horizontally, one, C′, for insertion into the auditory meatus and the other, D′, into the orbit. Each adjustable attachment consists of a rod C′, D′ fitted into a thick-walled tube. C, D, provided with a thumb-screw to lock the rod in position. The free end of each rod is shaped almost to a knife edge for a length of about 18 mm. The knife edge on C′ is on the upper surface, and that on D′ is on the

lower surface. The knife edges, when adjusted to support a skull, are in the same horizontal plane. Attachment C′ is not adjustable vertically, while D′ is adjustable both vertically and horizontally and it can be clamped in either direction by thumb-screws.

An adjustable part, E, attached to the front of the frame provides support under the maxillae; this part resembles a tuning fork with the handle attached to the kubus, and the two arms bent so as to give support under the maxillae. The two arms are separated about 20 mm. so as not to interfere with measuring, or drawing in the median sagittal plane.

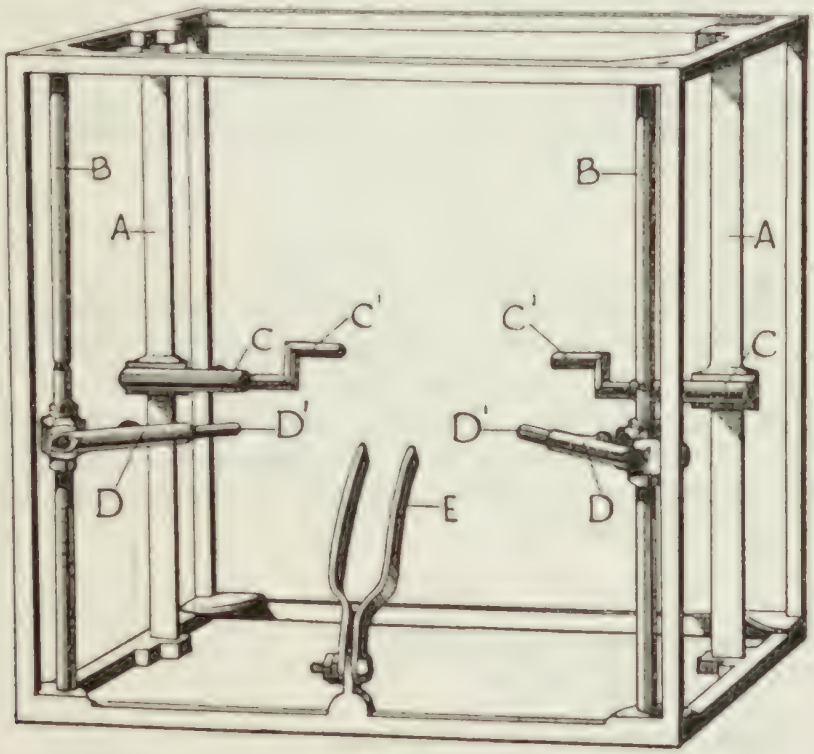

FIG. 1.

The two poria points can rest on the ends of the knife edges, or the ends can be inserted as far as necessary into the meati. In either case, the knife edge, resting against the inferior border of each orbit, must be adjusted vertically to correspond horizontally with the poria. If the inferior border of one orbit or one prorion is missing, a skull can still be orientated reasonably accurately. Fragile skulls can be given additional support in the kubus by means of thread, wire, or plasticine.

By turning the kubus so that different aspects rest on the bench, the skull can be orientated in the Frankfurt plane or in any plane at right angles to it.

Contour Drawings

The cranial contour drawings shown in Pls. VII, VIII and IX are made in accordance with directions given by Bennington (1) and Wagner (10). The modified kubus enables the sagittal and the transverse contours to be drawn at right angles to the Frankfurt plane, and not with the orientation used by Wagner and others. A skull may be supported face downwards while the transverse vertical drawing is made, and thus both right and left sides are directly represented in the drawing.

Craniometric Measurements

The anatomical points, between which measurements were made, are those defined by Buxton and Morant (3), with certain reservations suggested by Wagner (10). Points not anatomically obvious have been treated as closely as possible in accordance with the directions given by these writers.

Acknowledgments

My thanks are due to Dr. J. M. Baldwin, Government Astronomer of Victoria, for accurate adjustment of drawing apparatus; C. W. Brazenor for photographing the skull; D. J. Mahony, Director of the National Museum, Melbourne, for advice and revision of the manuscript; and Professor S. Sunderland, the University of Melbourne, for assistance in the location of various points on the Keilor skull.

Plates

IV. Skull with incrustation partly removed.
  Fig. 1. Right profile.
  Fig. 2. Left profile.
V. Skull with incrustation partly removed.
  Fig. 1. Front.
  Fig. 2. Back.
VI. Skull with incrustation partly removed.
  Fig. 1. Top.
  Fig. 2. Base.
VII. Sagittal contour.
VIII. Horizontal contour.
IX. Transverse contour.

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Table II

Measurements of Type Contours: Keilor Skull and Mean Values of Racial Groups (Males)

		Keilor	*Tasmania*		*Total Australia*		*North Australia*		*South Australia*		*Maori*		*Marquesans*		*Sandwich Is.*	
Transverse Contours																
	MA	**120·0**	111·8	4	112·6	83	113·6	10	110·3	19	117·4	38	118·1	17	121·7	56
	1R	**62·5**	57·9	,,	56·1	,,	56·4	,,	56·4	,,	58·5	,,	59·1	,,	58·8	,,
	1L	**62·5**	57·9	,,	56·1	,,	56·4	,,	56·4	,,	58·5	,,	59·1	,,	58·8	,,
	M¼R	**66·5**	60·4	,,	59·7	,,	60·5	,,	59·7	,,	62·5	,,	62·8	,,	62·4	,,
	M¼L	**66·5**	61·4	,,	59·3	,,	59·6	,,	59·6	,,	62·2	,,	62·3	,,	62·0	,,
	2R	**67·0**	61·3	,,	59·8	,,	60·2	,,	59·8	,,	63·4	,,	64·2	,,	63·6	,,
	2L	**66·5**	62·0	,,	59·1	,,	58·9	,,	59·8	,,	63·0	,,	63·0	,,	62·4	,,
	3R	**69·0**	63·6	,,	62·2	,,	62·2	,,	61·7	,,	65·1	,,	66·5	,,	65·7	,,
	3L	**68·5**	65·4	,,	61·5	,,	60·5	,,	62·0	,,	64·8	,,	65·3	,,	65·1	,,
	4R	**70·5**	66·1	,,	64·2	,,	64·2	,,	63·3	,,	67·2	,,	69·2	,,	68·8	,,
	4L	**72·5**	68·4	,,	63·3	,,	62·3	,,	63·6	,,	66·6	,,	67·5	,,	68·0	,,
	5R	**68·5**	66·3	,,	64·5	,,	64·8	,,	63·4	,,	67·5	,,	69·9	,,	69·8	,,
	5L	**72·5**	68·5	,,	63·4	,,	62·8	,,	63·3	,,	66·7	,,	68·2	,,	69·1	,,
	6R	**66·5**	65·5	,,	63·3	,,	63·7	,,	62·3	,,	66·0	,,	68·9	,,	69·6	,,
	6L	**71·0**	67·8	,,	62·2	,,	62·0	,,	62·1	,,	65·6	,,	67·5	,,	69·0	,,
	7R	**64·0**	63·4	,,	61·2	,,	61·6	,,	59·9	,,	63·8	,,	67·2	,,	68·1	,,
	7L	**69·0**	65·5	,,	59·4	,,	59·6	,,	59·6	,,	63·5	,,	65·9	,,	67·7	,,
	8R	**59·0**	58·4	,,	56·8	,,	57·2	,,	55·4	,,	59·5	,,	63·7	,,	64·2	,,
	8L	**64·0**	60·6	,,	55·2	,,	55·0	,,	54·7	,,	59·0	,,	61·7	,,	63·5	,,
	9R	**50·0**	50·0	,,	47·6	,,	48·3	,,	46·0	,,	50·3	,,	55·8	,,	54·7	,,
	9L	**53·5**	50·9	,,	45·6	82	45·6	,,	45·2	,,	49·4	,,	52·7	,,	53·7	,,
	10R	**32·5**	30·6	,,	32·7	83	33·3	,,	31·1	,,	34·0	,,	39·4	,,	36·9	,,
	10L	**34·5**	33·1	,,	31·0	82	30·9	,,	30·6	,,	32·8	,,	36·2	,,	36·1	,,
	A¼R	**17·0**	14·4	,,	16·6	83	17·0	,,	15·2	,,	16·2	,,	19·3	,,	17·2	,,
	A¼L	**14·0**	16·6	,,	15·4	82	15·4	,,	15·1	,,	15·0	,,	17·6	,,	17·5	,,
	ZR	**66·0**	61·0	,,	60·1	83	60·9	,,	60·2	,,	63·9	,,	63·6	,,	63·3	,,
	ZL	**67·0**	61·9	,,	59·7	,,	60·1	,,	60·2	,,	63·4	,,	63·0	,,	62·7	,,
	XR	**2·5**	4·3	,,	3·4	,,	4·3	,,	3·4	,,	5·2	,,	3·7	,,	4·2	,,
	XL	**4·0**	4·1	,,	3·6	,,	4·9	,,	3·7	,,	5·0	,,	4·1	,,	4·7	,,
Horizontal Contours																
	FO	**195·0**	185·8	4	184·6	82	180·1	9	186·8	19	184·7	38	182·5	16	180·8	56
	F¼R	**34·0**	29·8	,,	26·4	,,	24·3	,,	25·8	,,	22·3	,,	24·4	,,	23·9	,,
	F¼L	**29·5**	24·9	,,	27·1	,,	25·1	,,	26·3	,,	22·4	,,	25·9	,,	23·4	,,
	F½R	**41·0**	37·0	,,	37·5	,,	37·9	,,	36·5	,,	36·7	,,	36·0	,,	36·3	,,
	F½L	**39·5**	33·8	,,	37·5	,,	37·8	,,	36·4	,,	36·7	,,	36·3	,,	35·3	,,
	2R	**52·5**	48·0	,,	49·1	,,	49·9	,,	48·5	,,	48·3	,,	46·6	,,	47·6	,,
	2L	**50·5**	45·6	,,	48·5	,,	48·9	,,	48·0	,,	48·1	,,	46·6	,,	46·2	,,
	3R	**51·5**	48·4	,,	48·5	,,	48·3	,,	48·4	,,	48·8	,,	49·9	,,	48·3	,,
	3L	**52·5**	47·8	,,	47·9	,,	47·6	,,	48·2	,,	48·6	,,	50·1	,,	47·5	,,
	4R	**56·0**	51·4	,,	52·9	,,	53·8	,,	53·1	,,	55·6	,,	55·4	,,	54·8	,,
	4L	**58·0**	52·8	,,	52·4	,,	53·4	,,	52·8	,,	55·0	,,	55·8	,,	53·9	,,
	5R	**64·0**	60·6	,,	59·7	,,	59·7	,,	59·5	,,	63·1	,,	64·0	,,	63·0	,,
	5L	**65·0**	60·9	,,	58·6	,,	59·2	,,	58·8	,,	62·4	,,	63·6	,,	61·3	,,
	6R	**69·5**	67·3	,,	64·3	,,	63·3	,,	63·9	,,	67·5	,,	69·3	,,	68·9	,,
	6L	**71·0**	67·0	,,	62·9	,,	62·5	,,	62·7	,,	66·8	,,	68·7	,,	66·4	,,
	7R	**71·0**	69·9	,,	65·9	,,	65·0	,,	65·5	,,	68·6	,,	71·0	,,	71·3	,,
	7L	**72·5**	69·1	,,	64·2	,,	63·4	,,	64·0	,,	67·6	,,	70·1	,,	68·3	,,
	8R	**67·5**	68·0	,,	63·4	,,	62·3	,,	63·3	,,	65·4	,,	68·3	,,	68·6	,,
	8L	**68·5**	66·6	,,	62·2	,,	61·1	,,	62·1	,,	64·3	,,	67·4	,,	65·8	,,
	9R	**59·0**	58·3	,,	56·9	,,	56·0	,,	56·8	,,	58·3	,,	61·7	,,	61·6	,,
	9L	**60·5**	59·1	,,	55·8	,,	54·2	,,	56·0	,,	57·3	,,	61·1	,,	59·2	,,
	10R	**43·0**	42·8	,,	44·3	,,	43·2	,,	44·0	,,	45·8	,,	49·1	,,	48·5	,,
	10L	**44·0**	43·9	,,	43·2	,,	40·5	,,	43·2	,,	44·7	,,	48·9	,,	47·1	,,
	O¼R	**23·0**	23·3	,,	25·1	,,	25·2	,,	24·1	,,	27·0	,,	29·5	,,	29·6	,,
	O¼L	**26·0**	26·8	,,	24·5	,,	22·6	,,	24·0	,,	26·6	,,	29·8	,,	28·9	,,
	TR	**54·0**	51·4	,,	52·1	,,	53·1	,,	51·7	,,	49·9	,,	48·8	,,	49·6	,,
	TL	**51·0**	51·2	,,	51·1	,,	51·8	,,	50·3	,,	49·3	,,	48·0	,,	47·6	,,
	XR	**21·5**	25·1	,,	23·5	,,	24·1	,,	23·4	,,	20·5	,,	19·9	,,	20·4	,,
	XL	**20·0**	27·3	,,	22·4	,,	22·8	,,	21·9	,,	20·4	,,	18·6	,,	19·5	,,

TABLE II—(*Continued*)

MEASUREMENTS OF TYPE CONTOURS: KEILOR SKULL AND MEAN VALUES OF RACIAL GROUPS (MALES)

Sagittal Contours		*Keilor*	*Tasmania*	*Total Australia*	*North Australia*	*South Australia*	*Maori*	*Marquesans*	*Sandwich Is.*
	Nγ	194·0	177·3 4	181·4 83	177·9 10	185·2 19	181·4 38	179·8 17	175·6 56
Vertex	x from N	99·0	90·3 ,,	92·1 ,,	93·8 ,,	91·4 ,,	100·3 ,,	104·2 ,,	103·4 ,,
	y	90·0	89·4 ,,	84·7 ,,	83·2 ,,	82·2 ,,	90·3 ,,	90·0 ,,	95·5 ,,
Bregma	x from N	71·5	69·6 ,,	75·2 ,,	76·3 ,,	76·4 ,,	74·7 ,,	76·1 ,,	72·3 ,,
	y	87·5	87·5 ,,	83·2 ,,	81·6 ,,	80·8 ,,	86·8 ,,	87·2 ,,	91·2 ,,
Glabella	Gx	3·0	6·0 ,,	4·7 ,,	4·2 ,,	4·4 ,,	3·7 ,,	3·1 ,,	4·3 ,,
	Gy	12·0	14·3 ,,	9·9 ,,	9·5 ,,	10·2 ,,	11·8 ,,	11·4 ,,	10·9 ,,
	O	22·0	27·6 ,,	25·3 ,,	21·7 ,,	23·2 ,,	25·8 ,,	24·6 ,,	27·9 ,,
	N½	35·5	39·1 ,,	35·2 ,,	33·0 ,,	35·9 ,,	40·9 ,,	39·9 ,,	41·7 ,,
	1	60·5	59·7 ,,	57·3 ,,	56·2 ,,	55·4 ,,	59·6 ,,	59·6 ,,	61·6 ,,
	2	74·5	73·4 ,,	70·5 ,,	66·7 ,,	68·6 ,,	73·0 ,,	73·3 ,,	76·3 ,,
	3	83·5	82·1 ,,	78·6 ,,	75·2 ,,	76·6 ,,	81·3 ,,	82·0 ,,	85·7 ,,
Ordinates above Nγ	4	88·5	87·4 ,,	83·0 ,,	80·9 ,,	80·9 ,,	86·6 ,,	86·7 ,,	91·0 ,,
	5	90·5	89·5 ,,	84·3 ,,	82·7 ,,	81·7 ,,	89·5 ,,	88·9 ,,	94·1 ,,
	6	89·0	89·4 ,,	83·3 ,,	82·4 ,,	80·3 ,,	89·7 ,,	89·8 ,,	95·2 ,,
	7	83·5	85·5 ,,	79·0 ,,	76·1 ,,	76·1 ,,	85·5 ,,	86·5 ,,	91·8 ,,
	8	71·0	74·7 ,,	69·3 ,,	69·4 ,,	65·7 ,,	74·7 ,,	76·6 ,,	82·8 ,,
	9	53·0	55·2 ,,	49·7 ,,	47·8 ,,	44·9 ,,	56·8 ,,	59·8 ,,	67·3 ,,
	γ½	22·0	22·9 ,,	23·7 ,,	23·3 ,,	19·4 ,,	30·8 ,,	34·0 ,,	42·8 ,,
	γ¼	13·5	24·5 ,,	17·7 ,,	17·4 ,,	13·6 ,,	24·0 ,,	25·6 ,,	35·6 ,,
	8	44·5	39·0 ,,	45·9 ,,	51·7 ,,	49·3 ,,	46·2 ,,	45·8 ,,	43·2 55
Ordinates	9	32·0	26·9 ,,	41·4 ,,	42·7 ,,	40·3 ,,	36·0 ,,	34·1 ,,	30·5 56
below Nγ	γ½	29·5	19·9 ,,	32·5 ,,	34·3 ,,	32·2 ,,	29·9 ,,	27·7 ,,	25·0 ,,
	γ¼	18·0	14·4 ,,	23·6 ,,	24·5 ,,	24·0 ,,	21·8 ,,	19·0 ,,	18·4 ,,
λ	x from γ	11·0	5·3 ,,	4·5 ,,	4·1 ,,	5·4 ,,	6·7 ,,	4·6 ,,	4·2 ,,
	y	40·5	34·6 ,,	25·5 ,,	21·4 ,,	21·1 ,,	34·7 ,,	34·4 ,,	41·4 ,,
Suborbital	x from N	9·0	11·0 ,,	10·9 ,,	9·2 ,,	10·3 ,,	8·9 ,,	8·4 ,,	9·3 ,,
Auricular	x from γ	94·5	87·0 4	91·5 83	89·3 10	93·7 19	90·8 38	91·1 17	84·5 56
	y	30·0	23·9 ,,	28·3 ,,	29·0 ,,	29·2 ,,	27·5 ,,	28·8 ,,	27·0 ,,
Opisthion	x from γ	59·5	52·5 ,,	55·0 ,,	54·2 ,,	56·3 ,,	54·7 ,,	53·8 ,,	47·3 55
	y	53·0	45·6 ,,	56·3 ,,	57·3 ,,	55·0 ,,	52·9 ,,	52·6 ,,	48·5 ,,
Inion	γI	30·0	—	44·2 ,,	44·7 ,,	47·3 ,,	37·9 ,,	35·9 ,,	29·7 56
	NI	188·5	—	168·8 ,,	167·2 ,,	170·2 ,,	169·4 ,,	168·3 ,,	165·7 ,,
Basion	γ bas	112·5	—	105·6 ,,	105·6 ,,	104·6 ,,	102·8 ,,	101·0 ,,	95·4 ,,
	N bas	110·0	—	102·3 ,,	102·3 ,,	102·0 ,,	103·8 ,,	103·7 ,,	104·7 ,,
Alveolare	N to AP	74·0	—	68·4 82	71·8 9	69·2 ,,	69·2 37	72·8 16	69·0 47
	Bas to AP	108·0	—	102·2 ,,	102·1 ,,	102·6 ,,	98·6 ,,	100·8 ,,	99·6 ,,
Nose	∠ of nasal prominence	103°	—	112·7° 81	116·0° ,,	108·3° ,,	117·4° ,,	116·1° ,,	114·3° 54
	NL	17·0	—	17·4 ,,	19·7 ,,	16·4 ,,	20·3 ,,	20·0 ,,	19·3 ,,
	Max. nasal Subt. x from N	8·0	—	7·8 ,,	9·0 ,,	7·6 ,,	8·6 ,,	8·5 ,,	8·4 ,,
	Max. nasal Subt. y	2·0	—	3·0 ,,	3·1 ,,	2·6 ,,	3·1 ,,	3·1 ,,	3·4 ,,
Frontal	Max. Subt. x from N to NB	52·0	—	51·0 83	49·4 10	51·1 ,,	51·5 38	52·0 17	52·3 56
	Max. Subt. y to NB	23·5	—	25·0 ,,	23·4 ,,	24·7 ,,	25·4 ,,	25·4 ,,	24·7 ,,
Occipital	Max. Subt. x from λ	58·5	—	48·1 ,,	49·6 ,,	44·4 ,,	52·9 ,,	55·5 ,,	56·2 ,,
	Max. Subt. y to λ opp.	34·0	—	27·5 ,,	26·4 ,,	27·8 ,,	29·8 ,,	28·1 ,,	26·7 ,,
NA base line	x from N	89·0	—	86·9 ,,	88·3 ,,	86·4 ,,	92·7 ,,	86·8 ,,	90·3 ,,
	y	70·0	—	73·0 ,,	72·3 ,,	71·7 ,,	71·2 ,,	71·5 ,,	72·2 ,,
GI base line	x from G	107·0	—	102·2 ,,	98·6 ,,	106·3 ,,	100·1 ,,	101·1 ,,	99·1 ,,
	y	100·5	—	104·2 ,,	104·1 ,,	102·8 ,,	106·3 ,,	106·2 ,,	107·9 ,,
P_1	x from AP	62·0	—	58·6 82	58·5 9	59·5 ,,	51·1 35	51·1 16	51·1 46
	y	18·0	—	16·8 ,,	17·7 ,,	17·0 ,,	16·5 ,,	17·7 ,,	17·6 ,,
P_2	x from AP	42·0	—	41·5 81	42·4 ,,	42·5 18	35·9 34	35·8 ,,	35·0 47
	y	14·5	—	15·3 ,,	16·6 ,,	15·0 ,,	15·0 ,,	17·6 ,,	16·3 ,,
P_3		64·5	57·2 4	59·9 ,,	61·9 ,,	60·9 19	65·3 37	67·6 17	64·8 50
P_4		63·5	54·9 ,,	57·4 82	58·9 ,,	58·6 ,,	62·8 36	64·2 ,,	61·7 52
P_5		59·5	50·9 ,,	52·4 ,,	53·7 ,,	53·9 ,,	56·2 ,,	56·0 ,,	54·0 53
P_6		60·5	49·6 ,,	52·6 ,,	54·2 ,,	53·5 ,,	53·6 35	55·8 ,,	52·7 ,,

FIG. 1

FIG. 2

The Keilor Skull

FIG. 1

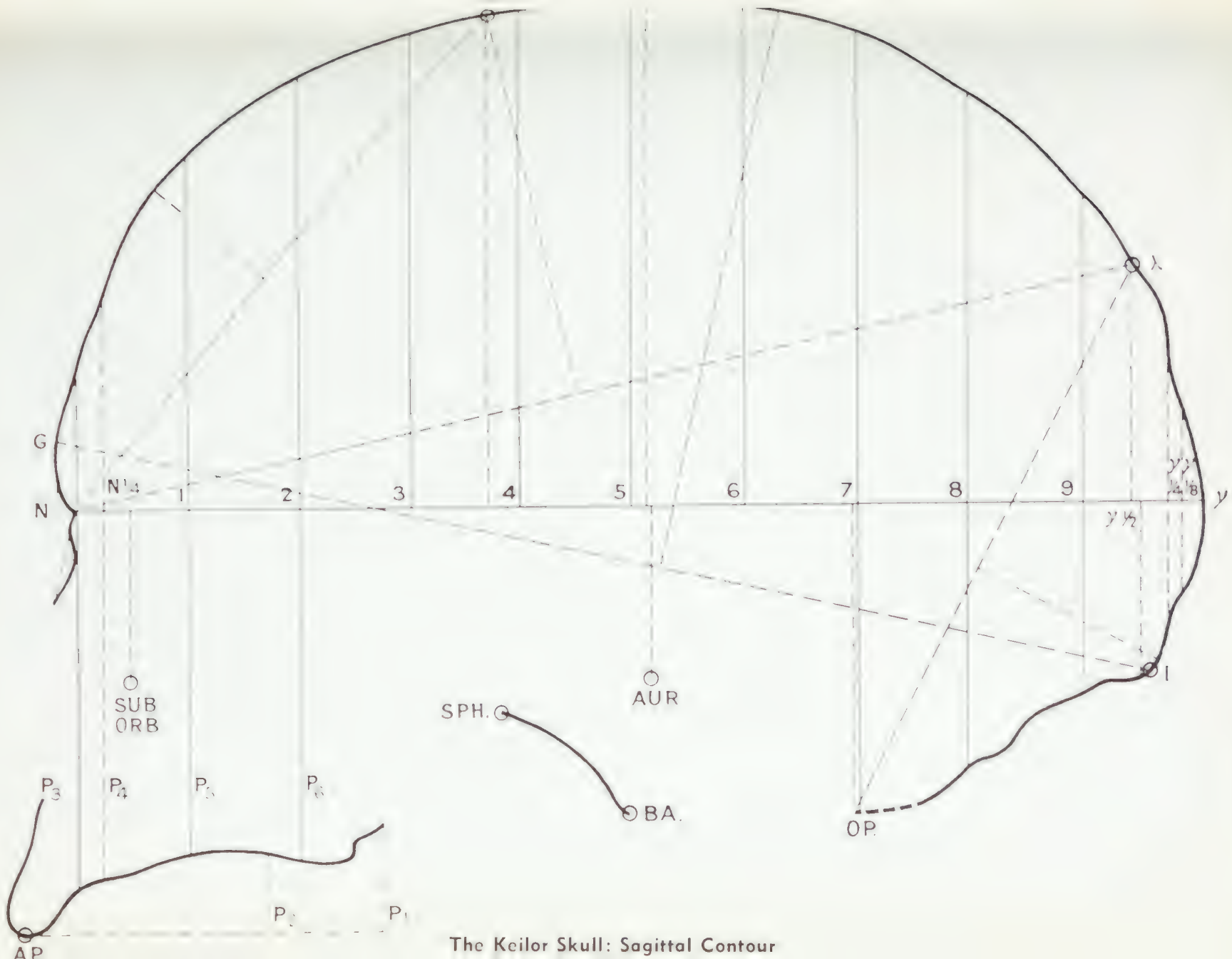
FIG. 2

The Keilor Skull

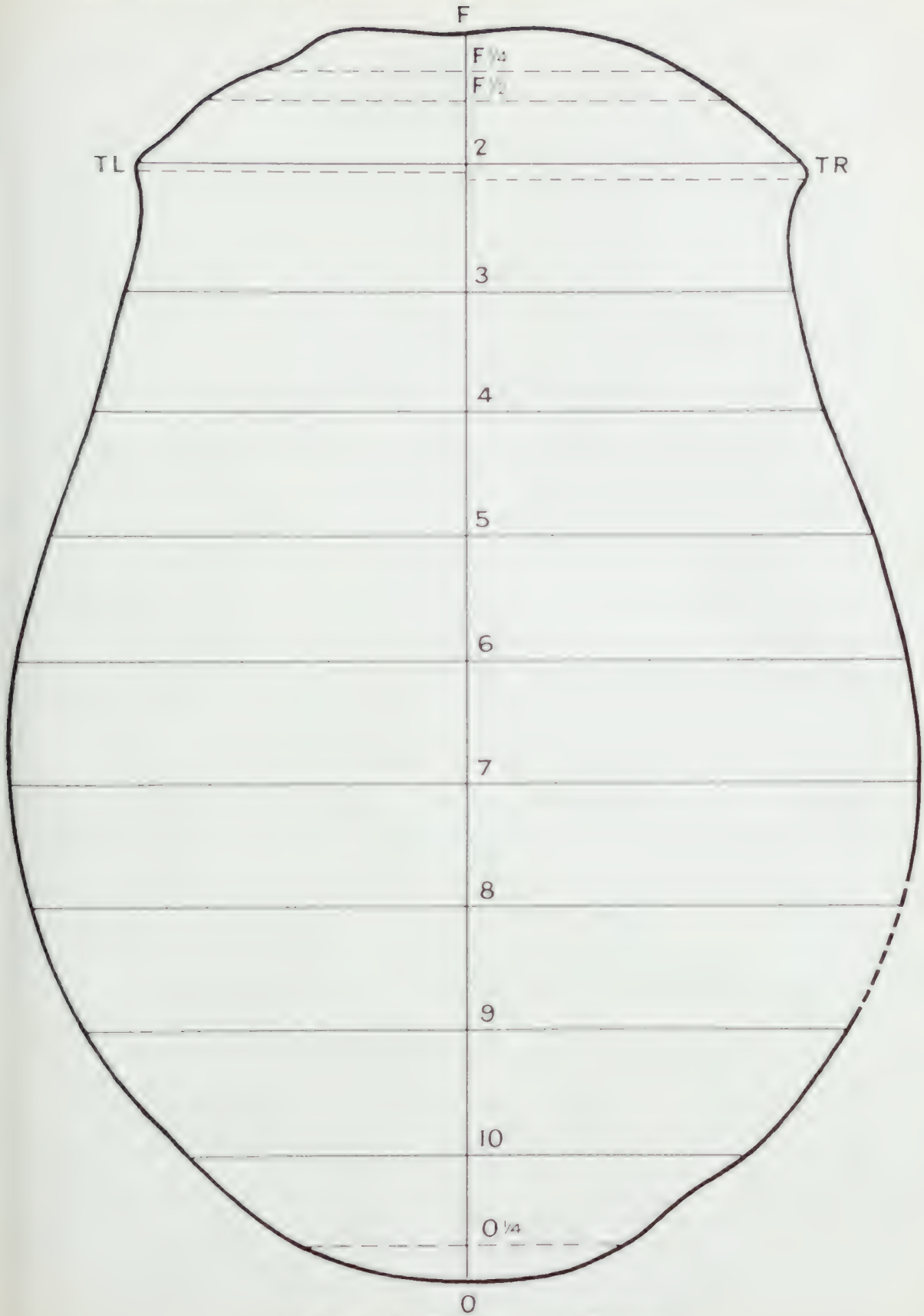
FIG. 1

FIG. 2

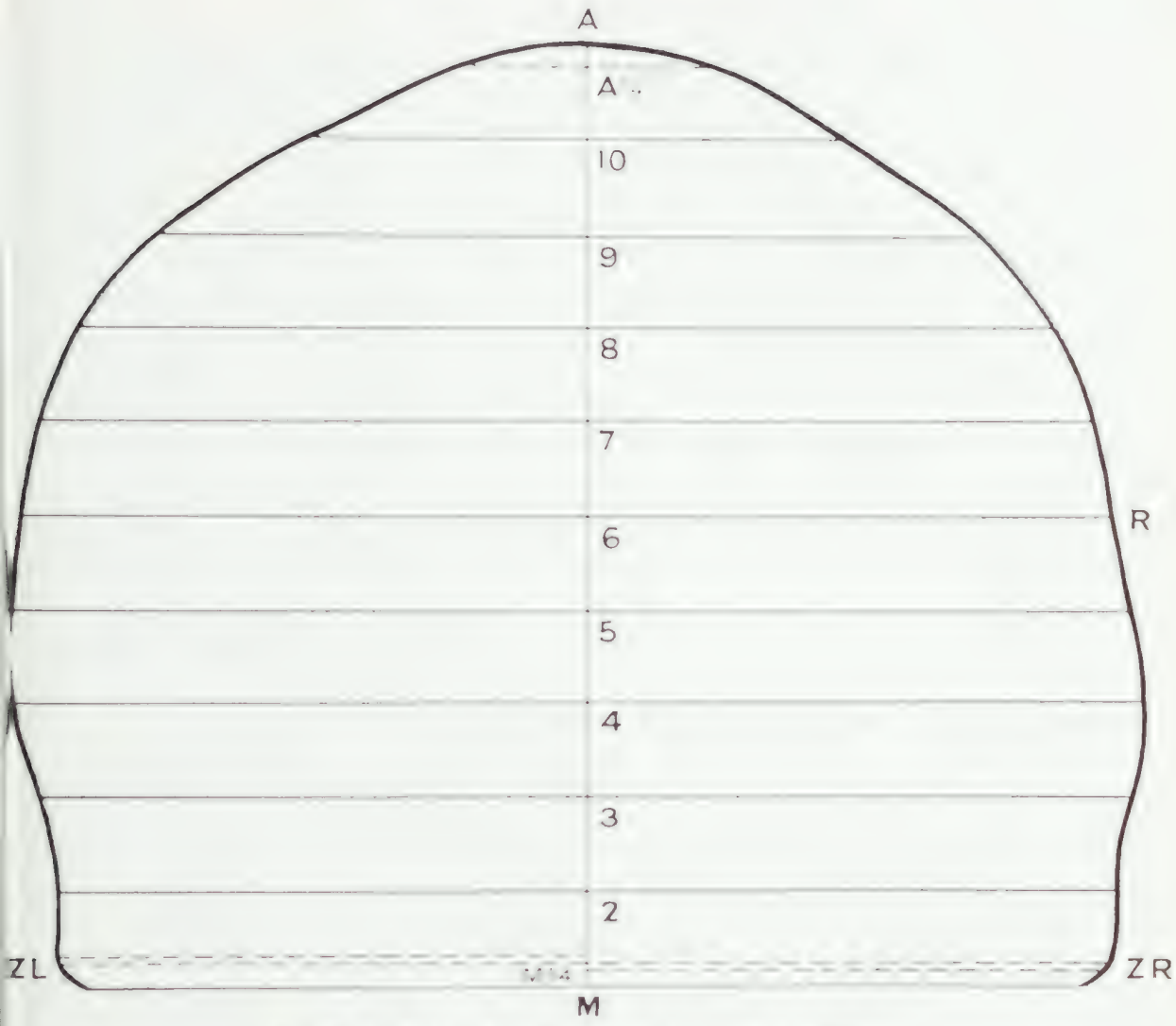
The Keilor Skull



The Keilor Skull: Sagittal Contour



The Keilor Skull: Horizontal Contour



The Keilor Skull: Vertical or Transverse Contour

THE KEILOR FOSSIL SKULL: PALATE AND UPPER DENTAL ARCH.

By William Adam, D.D.Sc.

Plates X-XI.

Standard anatomical terms are used in describing the palate and teeth; the methods adopted for measurements are those of the Galton Laboratory, London University. The points between which measurements were made are those defined by Buxton and Morant (3); in addition, other measurements suggested by Campbell (4) are included. Standard anthropometric instruments and modifications of standard precision instruments were used. Data concerning recent Australian aborigines are quoted from Campbell (4) and those for recent Tasmanian aborigines are from an unpublished thesis submitted by the author of this paper for the Degree of D.D.Sc., in which his researches on jaws and teeth of 56 Tasmanian skulls are recorded; a typescript copy of this thesis has been deposited in the Melbourne University Library.

Although measurements are recorded to one-tenth of a millimetre, it is not claimed that this degree of accuracy is attained in every instance owing to the difficulty of precisely locating the position of certain points since the alveolar margins have been slightly abraded post-mortem.

The mandible is missing.

The upper jaw is large, well developed and somewhat projecting. The infra-orbital (canine) fossa is large and deep. The right maxilla is slightly larger than the left.

The following measurements give figures for the Keilor skull, modern Tasmanians and modern Australians. G'H is the Nasion-Alveolar Point chord; LB, the Nasion-Basion chord; and GL, the Basion-Alveolar chord. LB and GL for the Keilor skull were measured by Dr. J. Wunderly. The Tasmanian group includes both males and females; the figures in brackets are maximum and minimum measurements.

The Australian group (males) is Morant's pooled A group, first sample (Morant, 6, p. 437); the figures in brackets indicate the number of specimens measured:

	Keilor	Tasmanian	Australian
G'H	74·2	63·2 (57·5-74)	66·8 (79)
LB	109	96·2 (88·5-111)	102·1 (137)
GL	108	96·3 (89-109)	103·2 (106)

Flower's method (5) of determining the degree of prognathism is used for estimating the Gnathic Index. The length of the Basion-Alveolar Point chord is multiplied by 100 and divided by the length of the Basion-Nasion chord.

$$\text{Gnathic Index} \quad \frac{\text{GL} \times 100}{\text{LB}}$$

Keilor skull	99·1
Tasmanian adults	101·4 (93·3-107·6)
Australian adults	104·5 (93·1-115·3)

The condition is thus expressed:

Orthognathous—when the index is below 98.
Mesognathous—when the index is between 98·1 and 103.
Prognathous—when the index is above 103.

The Keilor skull and average Tasmanians are therefore mesognathous and average Australians are prognathous.

The palate is large and the upper dental arch is horseshoe-shaped, with the third molars and post-dental processes curving well inwards (Pl. X, fig. 1). It is not quite symmetrical, the right side being slightly larger than the left. The sagittal suture is plainly visible, but the transverse and pre-maxillary sutures are obscure, possibly on account of incomplete removal of the calcareous incrustation which originally covered the whole palate. There is a narrow, low maxillary torus which is slightly higher on the left than on the right side; it is continuous with a large palatine torus. The palate is very broad in relation to its length.

An interesting feature is an unerupted tooth lying in the sagittal plane in the maxillary torus on the left side; it is probably a supernumerary tooth, since all teeth of the permanent dentition or their sockets are present. Most of the tooth is covered with bone and its form cannot be determined. Professor A. Amies of the Melbourne University radiographed the palate from various angles, but the calcareous incrustation in the nasal fossae prevented satisfactory results.

The following are measurements of the palate: the first three are those used by the Galton Laboratory and the remainder are Campbell's:

G'_1.	Palate length; from orale to staphylion, 56·5 mm.
G_2.	Palate breadth; distance between points on the alveolar border on the palatal side of the upper second molar teeth, 47·2 mm.
EH.	Palate depth from G_2 chord to the median palatal suture, 13·5 mm.
p.p.	Inner palatal width on the alveolar border opposite the second premolars, 41 mm.
c.c.	Inner palate width opposite the cuspids, 33·5 mm.

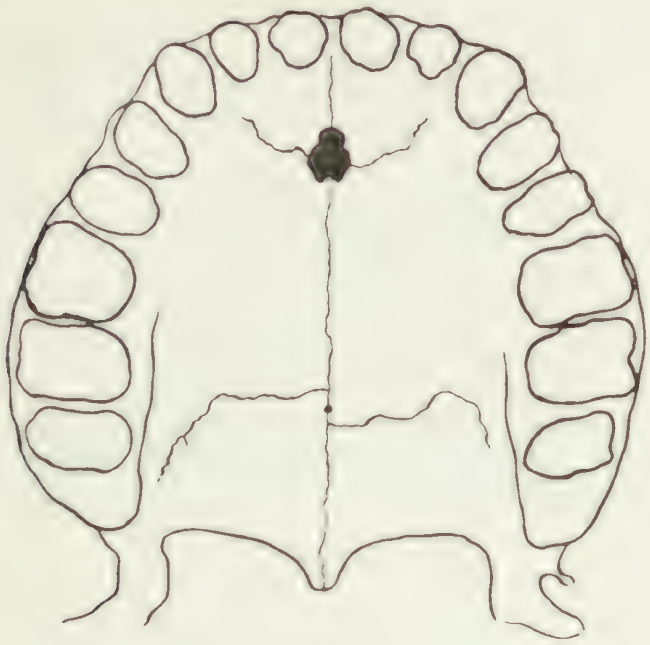


FIG. 1.
Keilor.

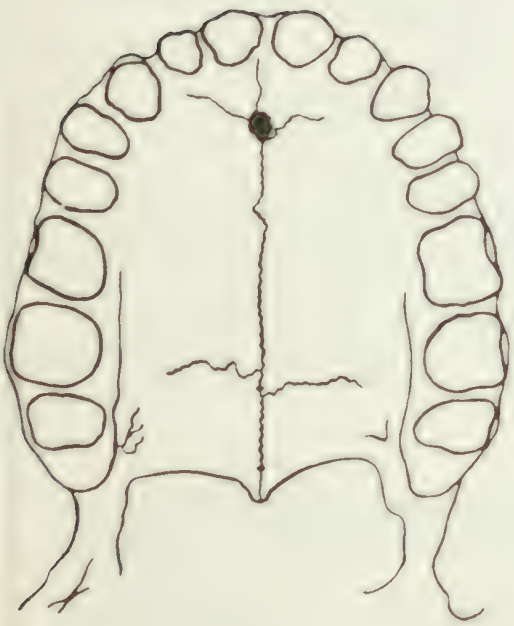


FIG. 2.
Tasmanian.

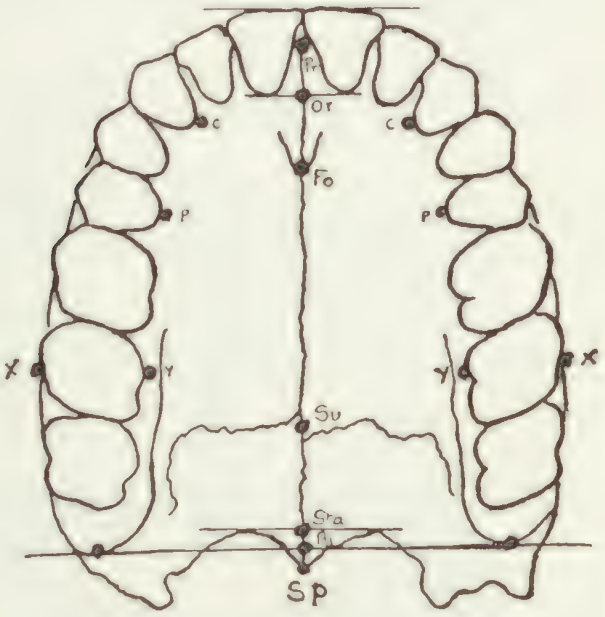


FIG. 3.
Australian (from Campbell, 1925).

Al.Sta.	Chord from alveolar point to staphylion, 59·5 mm.
Al.Sp.	Chord from alveolar point to tip of posterior nasal spine, 64·5 mm.
Su.Sta.	Chord between point of intersection of transverse palatal and median palatal sutures and staphylion, 16·3 mm.
Fo.Su.	Chord between posterior edge of incisive canal and transverse suture, 27·2 mm.
Pd.	Length of post-dental process, 11 mm.
x.x.	Maximum width of palate opposite second molar, 71·5 mm.
Max.L.	Maxillary length from alveolar point to alveolon, 61·3 mm.

Fig. 1 is a type contour of the palate, drawn by the method adopted by Campbell; fig. 2, a Tasmanian palate; and fig. 3 illustrates an Australian palate and the points used by Campbell (4, fig. 5, p. 37).

The Palatal Index as defined by Flower indicates the proportion of the breadth of the palate to its length; it is based on measurements of the external dimensions of the alveolar arch.

Palatal Index

$$\frac{\text{x.x.} \times 100}{\text{Max.L.}} = 116{\cdot}6$$

Turner (6) classified palates as dolichuranic, Palatal Index below 110; mesuranic, between 110 and 115; and brachyuranic,

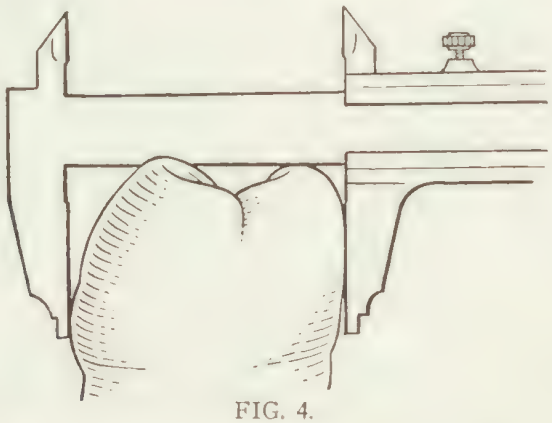


FIG. 4.

above 115. The Keilor skull and Tasmanians (average 111·9) are therefore brachyuranic, and Australians (average 107·7) dolichuranic.

The maxillae are intact; three molars on each side and the right second premolar are present, together with some roots of teeth which have broken off post-mortem. The sockets of all missing teeth are present. The bone at the necks of the teeth is slightly abraded. The arch is symmetrical, and the teeth are large and well formed. Attrition is marked, class 3 of Broca (2), and

there is a fair amount of inter-proximal wear. The teeth, though well worn, show no caries. There is some recession of the alveolar bony margins, but in life there was only slight if any pyorrhoea; post-mortem abrasion probably accounts for the slight loss of bone at the necks of the teeth.

It is possible to record only the mesio-distal and bucco-lingual diameters of the crowns of the teeth. These measurements were carefully taken, but are only approximate, since the crowns are worn by attrition; those on the left side are too worn for measurement.

With vernier callipers readings were taken to one-tenth of a millimetre. The crown measurements are the projective readings taken with callipers placed at right angles to the long axis of the teeth as shown in fig. 4. The terminology is that used by Black (1).

Mesio-distal Diameters.

	2nd Premolar	1st Molar	2nd Molar	3rd Molar
Keilor Skull	7·1	11·2	9·9	9·7
Recent Aust.	7·23(6·5-8·25)	11·43(10-13)	10·93(10-12·5)	10·3(8-13)
Tasmanian	7·6(6·2-8·8)	11·3(10·2-12·2)	11(10-12·5)	10·3(8·9-12·5)

Bucco-lingual Diameters.

	2nd Premolar	1st Molar	2nd Molar	3rd Molar
Keilor Skull	10·6	13·2	13	12
Recent Aust.	10·4(8·5-12)	12·84(11·5-14·75)	13·1(11-16)	12·33(10-15)
Tasmanian .	10·5(9·5-12·3)	12·7(11·4-14)	13(11·8-14·8)	12·5(11-13·7)

Summary and Discussion.

Typical Tasmanian and Australian palates and dental arches are shown in Plate XI for comparison with those of the Keilor specimen.

In the table below, measurements of the Keilor Skull and corresponding measurements of recent Australian and Tasmanian skulls are set out.

		Keilor	Australian	Tasmanian
	G'_1	56·5	51·5(46·5-59·5)	49(40·5-59)
	G_2 (YY)	47·2	39(32-44·5)	38·6(31-45·5)
	EH	13·5	10·95(7-17·5)	9·1(3·2-13)
(Pr)	Al.Sta.	59·5	57·8(51·5-67·5)	52·9(48·7-57·4)
(Pr)	Al.Sp.	64·5	62·7(51-73)	56·8(52·3-66)
	Su.Sta.	16·3	12·7(8-17·5)	9·9(6·2-14·7)
	Fo.Su.	27·2	29·4(20-35)	30·5(27·2-35·8)
	p.p.	41	34·2(30-41)	35·5(32-41)
	c.c.	33·5	26·4(22·5-31)	26·8(23·7-33)
	Pd.	11	8·85(4-15)	7·5(3·5-10·8)
	Max.L.	61·3	60·5(54-67)	56·4(51·5-61·5)
	x.x.	71·5	62·1(56-75·5)	63·8(57·5-71)

From these measurements it will be seen that the Keilor is larger than average Australian and Tasmanian skulls, but with the two exceptions of G_2 (the inner width of the palate between the 2nd molar teeth) and c.c., all measurements of the Keilor skull lie within those of the largest recorded Australian skulls. Seven of its measurements exceed the maxima of those recorded by the writer for Tasmanian skulls.

The Keilor skull with a Gnathic Index of 99·1 and the average Tasmanian skull with a Gnathic Index of 101·4 are mesognathic; the average Australian skull has a Gnathic Index of 104·5 and is prognathous.

The palate of the Keilor skull is very large and well developed. Though larger measurements are recorded by Campbell for some Australian skulls, the upper jaw of the Keilor skull is larger than most modern Australian jaws and is larger in a number of its measurements than any of the Tasmanian jaws examined by the writer.

The teeth of the Keilor skull, though slightly smaller in their mesio-distal diameters than the average corresponding Australian and Tasmanian teeth, are about the same size in bucco-lingual diameter; all measurements fall within the range of measurements for corresponding Australian and Tasmanian teeth.

The teeth are too much worn to admit a comparison of cusp form, but the type of wear is similar to that found in Australian and Tasmanian cusps. The food of Keilor man was evidently coarse and required vigorous mastication.

Any supernumerary tooth such as the one situated in the horizontal part of the left maxilla of the Keilor skull is rare in primitive skulls. No similar occurrence is recorded by Campbell in the series of 630 Australian skulls examined by him nor by the writer in Tasmanian skulls. Since radiographs were unsuccessful, it is impossible to determine its form without dissecting out the tooth.

A comparison of the Keilor palate with those of Tasmanians and Australians (Pl. VII and VIII) discloses that it is more Tasmanoid than Australoid in the following respects:

1. The palatal contour is horseshoe-shaped, with the third molars turning well inwards.
2. It is relatively broad like the Tasmanian palate (brachyuranic); the Australian palate is relatively narrower (dolichuranic).
3. Well-developed maxillary and palatine tori are present.
4. The infra-orbital fossa is deep.

To Mr. L. A. Baillôt of the Melbourne Technical College I am

indebted for the photographs reproduced in Plate X, fig. 1, and Plate XI, fig. 2.

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Plates

X. The Keilor Palate and Dental Arch.
XI. Fig. 1. Tasmanian Palate and Dental Arch.
2. Australian Palate and Dental Arch.

Fig. 1 (0·98 approx.)

Fig. 2

The Keilor Palate and Dental Arch

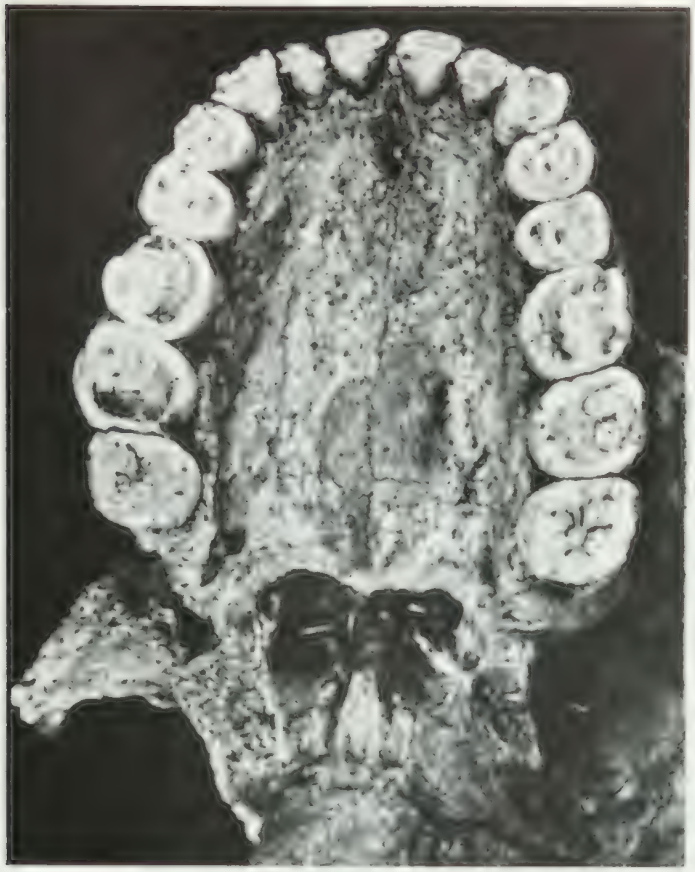

Fig. 1. Tasmanian (× 1·1 approx.)

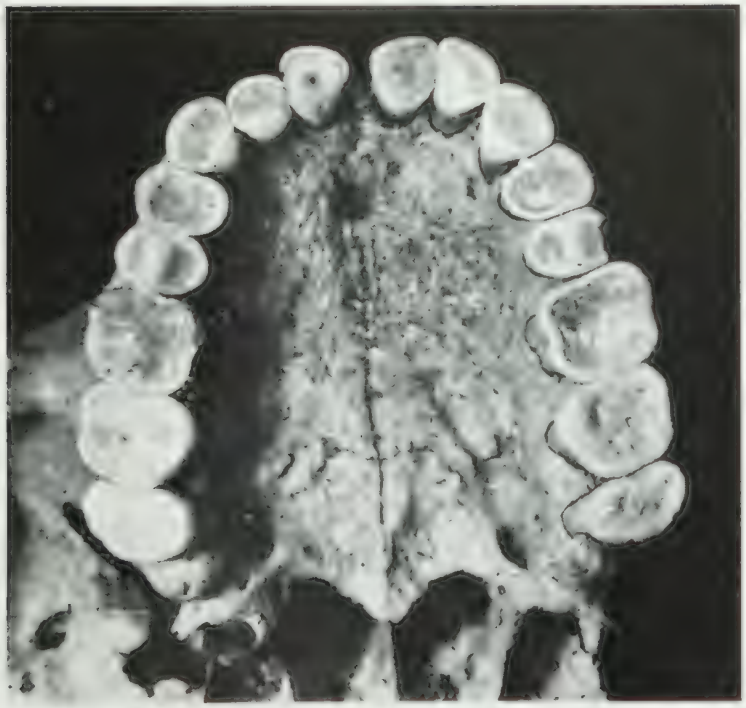

Fig. 2. Australian (× 1·02 approx.)

Typical Tasmanian and Australian Palates and Dental Arches

THE KEILOR FOSSIL SKULL: GEOLOGICAL EVIDENCE OF ANTIQUITY.

By D. J. Mahony, M.Sc., Director.

The following is a brief epitome of evidence concerning the age of the river terrace in which a human fossil skull was found near the junction of Dry Creek and the Maribyrnong River, a mile north of Keilor. The skull was unearthed beneath undisturbed strata at 18 ft. below the surface of the terrace, and skull and terrace are evidently contemporaneous.

These notes are based on field work carried out by R. A. Keble and Miss Hope Macpherson, but the inferences are my own. Mr. Keble is preparing a detailed paper on the subject, and he may interpret the evidence differently.

The area at the junction of Dry Creek and the Maribyrnong River was geologically mapped. In this locality there are fragments of three terraces which will be referred to as the Keilor, the Braybrook and the Maribyrnong Park Terraces. The surface of the Keilor Terrace, in which the skull was found, is on the 103 ft. contour and is 45 ft. above the adjacent river bed. The Braybrook and the Maribyrnong Terraces are respectively 36 ft. and 27 ft. above the river bed. The river is very shallow.

These terraces were traced downstream in the valley of the Maribyrnong River and their surface levels were determined at intervals with a dumpy level and between these points with an Abney level. The datum to which heights were referred is low water mark at Williamstown (L.W.M.), an official datum used in Victoria. The mean diurnal rise and fall of tide at Williamstown is 2 ft.

All the terraces are paired in some localities; in others erosion has reduced their area and in many places only fragments remain.

Keilor and Braybrook Terraces extend as far as Ascot Vale Gap, where the tidal portion of the river flows between two isolated basalt-topped hills about a mile apart. Maribyrnong Park Terrace extends about half a mile further and follows the old course of the river east of Quarry Hill, the eastern hill of Ascot Vale Gap.

Keilor Terrace between Dry Creek and Keilor is about a mile in length and a quarter of a mile wide, but its surface is disturbed by cultivation. Downstream, near the point where the electric transmission line crosses the river, it is about 150 yds. wide and it retains its natural surface. Its most southern portion is about 60 ft. above L.W.M.

Braybrook Terrace at Dry Creek is 7 ft. lower than Keilor Terrace, and at Chinaman's Ford, where the river becomes tidal,

the difference in level is 14 ft. The largest surviving fragment is about a mile long and a third of a mile wide and is situated at Braybrook near the western hill of Ascot Vale Gap. Its surface level is here 52 ft. above L.W.M.

Maribyrnong Park Terrace at Dry Creek is 18 ft. lower than Keilor Terrace and at Chinaman's Ford the difference is 35 ft. The largest remaining portion extends from a little above Ascot Vale Gap east and south of Quarry Hill and is about one mile by half a mile in area. Maribyrnong Park is situated on it. The surface level in this locality is 32 ft. above L.W.M.

Below Ascot Vale Gap, the river has formed an extensive alluvial estuarine flat, the surface of which is about 10 ft. above L.W.M. and the adjacent tidal portion of the river. Flemington Racecourse is situated on it, and it may be named the Flemington Terrace. It merges into the Yarra Delta, the surface of which is about 8 ft. above L.W.M.

The delta deposits are up to 50 ft. thick (Selwyn, 1854) and occupy a drowned valley (Hall, 1909). At Coode Canal, *Arca trapezium*, a species now rare in Port Phillip Bay, is very abundant at 23 ft. below the surface (Lucas, 1887) and remains of *Diprotodon* were found at 35 ft. in estuarine sand in the Moonee Ponds Creek valley a mile north of the Footscray railway (Pritchard, 1899). These organisms suggest some antiquity but do not prove the delta deposits to be Pleistocene in age.

Age of the Terraces

An outstanding feature of Pleistocene times is a series of eustatic changes in sea level. Relative to present sea level, the level fell during glacial phases and rose during interglacial phases. In Holocene times it fell 10-20 ft. owing to a slight fall in temperature some thousands of years ago (Daly, 1934).

Bearing these facts in mind, the following tentative correlations are made.

The surfaces of the Flemington Terrace and the Yarra Delta were slightly below sea level immediately before the Holocene eustatic fall.

The drowned valley occupied by Flemington Terrace and the Delta represents the eustatic fall in sea level during the most recent glacial phase, the Würm.

Keilor, Braybrook and Maribyrnong Park Terraces represent the eustatic rise of sea level during the Riss-Würm interglacial phase. Their heights above sea level correspond to the 40-50 ft. raised beaches of northern Tasmania which Edwards (1941) correlated with the Riss-Würm interglacial phase. Their differences in

elevation may represent eustatic fall in sea level caused by decreasing temperatures towards the end of the Riss-Würm interglacial phase.

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A REVISION OF THE GENUS *PROMYRMECIA* EMERY (FORMICIDAE).

By John Clark,
Entomologist, National Museum.

Plates XII-XVII.

Following a study of the large Australian genus *Myrmecia* it has been considered necessary to divide the species still further. At present two subgenera are recognized; they are *Myrmecia* s. str. and *Promyrmecia* Emery. In the following pages it is proposed to raise *Promyrmecia* to full generic rank as their stature and jumping habits render them quite distinct from the large non-jumpers of the genus *Myrmecia*. The status and species of the genus *Myrmecia* will be dealt with in a subsequent paper.

In the genus *Promyrmecia* 55 forms are recorded herein; of these 24 are described as new. Most of the species are very local and rare, few being at all common. Only one species, *P. pilosula* Smith, the "black jumper," is found in all the States. With our present knowledge little can be said on the distribution of the genus. The species appear to be found mainly in Southern Australia, ranging round the coastal area from Geraldton, Western Australia, to Cairns, North Queensland. Few are known from more than one hundred miles inland and none from North-Western Australia and Northern Territory.

Many of the species construct a mound over the nest and a few make their nest under large stones or logs. The majority nest deep in the ground, generally the nest is about 18 inches deep without traces of a mound; such nests are difficult to find unless the ants are seen to enter or leave. These nests have several small entrances scattered over about two square feet. When disturbed the ants swarm out from all entrances and advance in a series of jumps, the jump averaging one and one-half inches along the ground and about half that in height. The longest jump so far measured is three and one-fourth inches. Most of the species are very savage, while a few are quite timid, but all sting severely.

The males and females fly during the summer months, mostly during January and February.

Unless otherwise stated the Types are in the National Museum, Melbourne.

Family **FORMICIDAE** Latreille, 1810

Subfamily **Ponerinae** Lepeletier, 1836

Genus PROMYRMECIA Emery

Myrmecia Fabricius Subgenus *Promyrmecia* Emery. Genera Insectorum, fasc., 118, pp. 18-19, 1911.

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Myrmecia Fabr. Subgenus *Pristomyrmecia* Viehmeyer. Ent. Mitteil. Berl., xxiii, pp. 220-21, 1924.

Myrmecia Fabr. Subgenus *Promyrmecia* Clark. Vict. Naturalist, xlii, pp. 139-40, 1925; Wheeler, Colony-founding among Ants, pp. 54-55, 1933; Clark, Mem. Nat. Mus. Vict., viii, p. 9, 1934.

Worker. Moderately large ants (4-16 mm.) with well-developed hind legs enabling them to make leaps of from one to four inches along the ground. Mandibles linear, calliper-like, usually shorter than head, furnished with both large and small teeth of various forms. Antennae slender, twelve segments, scapes short, rarely extending beyond occipital border; second segment of funiculus longer than first. Eyes large and globular, occupying the anterior fourth of the sides of head; ocelli large and prominent. Thorax usually twice as long as broad, mesonotum separated from the epinotum by a deep and wide suture. Node large, usually as long as broad, stalk in front very short; ventral surface with a more or less developed spine in front. Postpetiole bell-shaped, strongly constricted behind, much narrower than the abdomen. Legs robust, femur of the posterior pair more or less incrassated toward the base. Claws large, bifurcated near middle.

Female. Similar to the worker but larger, more robust and winged. In general the head broader; mandibles shorter, broader and with stronger teeth; node and postpetiole broader. Wings with two discoidal cells.

Ergatoid females are common in the nests of most species. The development of the mesonotum and scutellum varies considerably in these females.

Male. Smaller than the female, colour and sculpture similar. Head small, convex; mandibles short, triangular, with few, if any, teeth. Clypeus large and convex. Antennae with thirteen segments; scapes short, rarely more than twice as long as first segment of funiculus, second segment longest. Eyes large, occupying fully half the sides of head. Ocelli large. Mesonotum with distinct mayrian and parapsidal furrows. Nodes similar but smaller and more slender. Legs long and slender, claws bifurcate. Anterior wings with two discoidal cells. Cerci long. Genital armature; stipes arched, volsella and lacina laminate.

Genotype *Promyrmecia aberrans* Forel

The genus is divided into seven groups based on the size and shape of the mandibles and scapes of the workers. In many species the head of the female differs greatly from that of the worker. Text fig. 1 illustrates the differences in the chief species of each group.

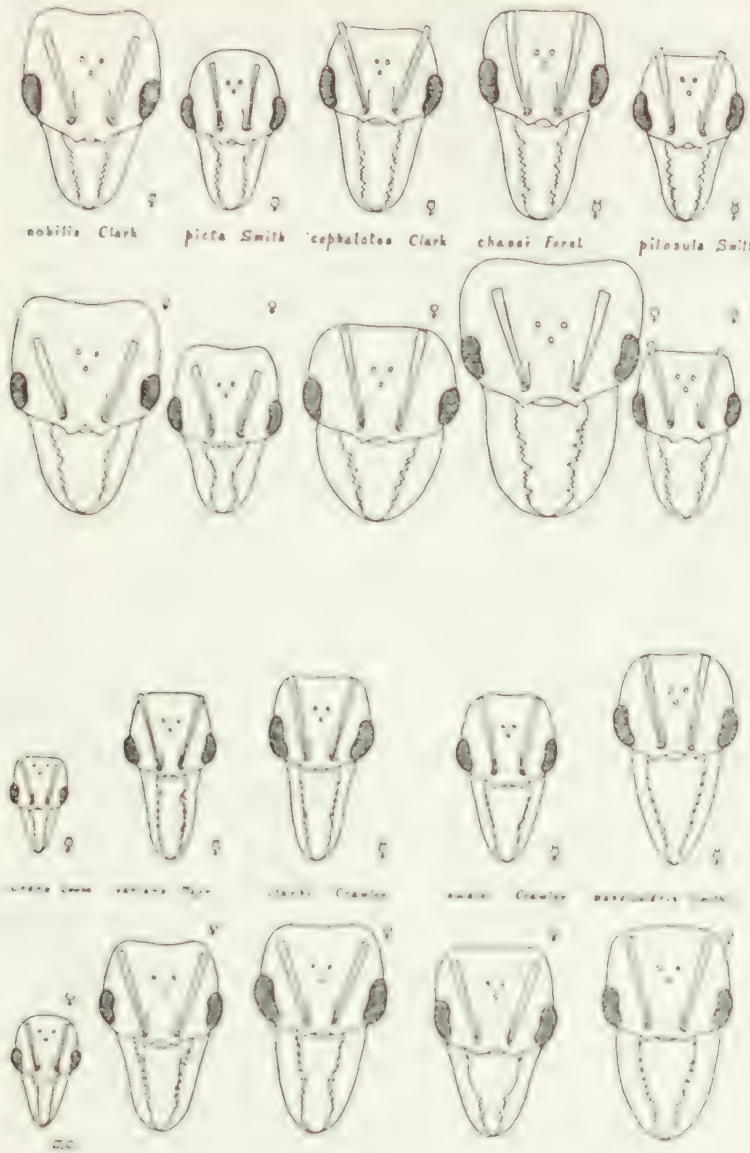

FIG. 1.

KEY TO GROUPS

1. External borders of mandibles concave 37
   2. Head and thorax with large more or less obsolete striae 12
      1. Mandibles broad, one-fourth shorter than head, furnished with short, broad teeth. Scapes extend to posterior sixth of head, as long as mandibles . . . . . aberrans Forel
13. Head and thorax striate-rugose 21
   2. Mandibles one-sixth shorter than head, broadest at basal third, teeth longer and sharper. Scapes extend to posterior sixth of head, one-fifth shorter than mandibles . . picta Smith

22. Head and thorax finely striate 37
    3. Mandibles linear, almost as long as head, as long as scapes, furnished with four large teeth interspersed with smaller teeth. Scapes extend to, or very slightly pass, occipital border .. .. pilosula Smith

38. External borders of mandibles convex 42
    39. Head and thorax striate 41
        4. Mandibles slightly longer than head, teeth as in pilosula group. Scapes extend slightly beyond occipital border .. .. cephalotes Clark

43. External borders of mandibles concave. Head and thorax finely striate-rugose 48
    5. Mandibles slender, slightly longer than head, teeth small, hook-shaped and directed backwards. Scapes extend to occipital border .. varians Mayr

49. Head and thorax finely striate 55
    6. Mandibles slender, straight or very feebly concave, as long as, or slightly longer than head, five apical teeth erect, behind these the teeth, shorter, broader and directed backward, sawtooth-shaped. Scapes extend to occipital border .. .. tepperi Emery

56. External borders of mandibles straight or feebly convex. Head and thorax strongly striate 66
    7. Mandibles slightly longer than head, slender, almost parallel, five apical teeth large and erect, behind these the teeth obsolete, very short, directed backward, sawtooth-shaped. Scapes extend to occipital border .. .. .. mandibularis Smith

Key to Species.

1. External borders of mandibles concave 37
    2. Head and thorax with large more or less obsolete striae 12
        3. Black; dorsum of pronotum and epinotum and whole of node bright red; mandibles, clypeus and antennae reddish-yellow. Mesonotum smooth in middle, with some large shallow punctures, a few obsolete striae at sides. Node irregularly rugose. Length 12 mm. .. .. aberrans Forel
        *4. Head, thorax and petiole blood red, mandibles and antennae reddish-yellow. Posterior corners of head very smooth and shining. Mesonotum longitudinally or obliquely rugose. 10-13 mm. .. .. formosa Wheeler
        *5. Black; a large spot behind each eye, one on disc of pronotum and upper surface of node blood-red. Mandibles and antennae reddish. Mesonotum with feeble and oblique rugose. Node smooth. 10-13 mm. .. .. .. haematosticta Wheeler

*From description only.

*6.	Colour as in *froggatti*; body more opaque, rugae on mesonotum arcuate and transverse, epinotum and node reticulate. 15 mm.	taylori Wheeler
*7.	Colour as in *taylori*. Mesonotum coarsely punctate, with indistinct traces of transverse rugules, anterior of epinotum indistinctly rugose, node more coarsely and distinctly rugose. 14 mm.	sericata Wheeler
8.	Posterior half of head, all the thorax and node blood-red, front of head and the legs brownish-black; mandibles, antennae and tarsi yellow. Mesonotum striate transversely. Node coarsely reticulate. 11-12 mm.	froggatti Forel
9.	Black; mandibles, antennae and tarsi reddish-yellow, teeth of mandibles blackish-brown. Mesonotum striate longitudinally. Node irregularly punctate-rugose. 11-13 mm.	maura Wheeler
10.	Black; dorsum of pronotum, mesonotum, epinotum and node bright red; mandibles yellowish-red, antennae and tarsi brownish. Mesonotum smooth and shining with a few scattered shallow punctures. Node circularly striate. 10-14 mm.	nobilis sp. nov.
11.	Head yellowish-red with a broad brown line across forehead, pronotum and node bright red, mesonotum and epinotum reddish-brown, tarsi reddish. Mesonotum striate-rugose longitudinally. Node coarsely and irregularly rugose. 14·5 mm.	eupoecila sp. nov.
12.	Head, thorax and node red, mandibles and antennae testaceous, legs brown. Mesonotum coarsely and irregularly punctate-rugose. Node irregularly rugose, with a central longitudinal carina. 15·5 mm.	greavesi sp. nov.
13.	Head and thorax striate-rugose	21
14.	Black; mandibles, clypeus, front of face to about the posterior margin of eyes yellow; antennae and anterior legs reddish-yellow, intermediate and posterior legs brownish. Mesonotum finely and transversely rugose. Node irregularly rugose. 9-12 mm. . . .	picta Smith
15.	Red; posterior half of head and two apical segments of gaster black. Mesonotum finely and transversely striate. Node coarsely and irregularly rugose. 10-11·5 mm.	fucosa Clark
16.	Black; basal half of mandibles and the labrum yellow, apical half of mandibles, anterior tibiae and apical half of femora and all tarsi reddish-yellow; dorsum of pronotum, epinotum and node red. Mesonotum	

*From description only.

with faint traces of rugae. Node irregularly rugose. 6-8 mm. . . . . urens Lowne

17. Black; mandibles yellow; clypeus, antennae and legs reddish-yellow; epinotum and node red. Mesonotum coarsely reticulate. Node irregularly rugose. 6-8 mm. . . . . infima Forel

18. Black; apical half of mandibles brown, basal half reddish-yellow; antennae and legs brown; apical half of funiculus and the tarsi reddish; pronotum, epinotum and node more or less marked with red. Mesonotum finely and longitudinally striate-rugose. Node irregularly rugose. 7-9·5 mm. . . . . nigra Forel

19. Black; mandibles and labrum yellow; funiculus, epinotum, node, postpetiole and all legs reddish, scapes brown. Mesonotum and node densely reticulate. 5·5-6·5 mm. . . . rubicunda sp. nov.

20. Blackish-brown, mandibles yellow; antennae, pronotum, mesonotum and legs brown or reddish-brown, epinotum and node red. Mesonotum with obsolete coarse rugae. Node reticulate-rugose. 4-4·5 mm. . . . . exigua sp. nov.

21. Black; dorsum of node and a large spot on epinotum red; apex of mandibles, labrum and funiculus reddish-yellow, scapes brown. Mesonotum longitudinally striate-rugose. Node coarsely and irregularly rugose. 7-9 mm. . . . . dichospila Clark

22. Head and thorax finely striate 37

23. Black; mandibles, antennae, tibiae and tarsi yellow. Mesonotum longitudinally striate. Node circularly rugose. 12-14 mm. . . . . pilosula Smith

24. Black; mandibles, antennae and legs brown, tarsi reddish, dorsum of gaster covered with golden-red pubescence. Mesonotum finely striate longitudinally. Node irregularly rugose. 10-12 mm. . . . . michaelseni Forel

25. Colour as in *michaelseni* but pubescence on gaster more yellowish. Sculpture coarser. 11-13 mm. . . . . queenslandica Forel

26. Black; mandibles, antennae and legs reddish-brown. Pubescence on gaster yellow, very fine, hiding sculpture on first segment. Mesonotum finely striate longitudinally. Node and postpetiole striate-rugose longitudinally. 12-14 mm. . . . . ruginodis sp. nov.

27. Black; mandibles and anterior coxae brown; legs, including middle and posterior coxae yellow. Gaster densely covered with golden yellow pubescence. Mesonotum and node longitudinally striate. 9 mm. . . . . chrysogaster sp. nov.

28. Black; mandibles yellow, darker at apex, antennae and legs brown, tarsi reddish-brown. Pubescence on postpetiole and gaster forming a dense yellow covering. Mesonotum striate-rugose longitudinally. Node coarsely and irregularly punctate-rugose. 9-12 mm. . . . . cydista sp. nov.

29. Head, postpetiole and gaster black, thorax and node bright red; mandibles, apical segments of funiculus and tarsi yellow, antennae and legs brown. Pubescence on gaster yellowish, long and abundant but not hiding the sculpture. Mesonotum striate longitudinally. Node striate circularly. 12-15·5 mm. . . . . chasei Forel

30. Similar to *chasei* but the anterior portion of pronotum, disc of mesonotum, lower half of mesosternum and metasternum black. 12-15 mm. . . . . ludlowi Crawley

31. Head and gaster black; thorax, node and centre of postpetiole yellowish-red; mandibles yellow, antennae and tarsi reddish-yellow; legs, coxae and base of metasternum brown. Mesonotum and node feebly and irregularly rugose. Postpetiole longitudinally striate-rugose. 10·5 mm. . . . . harderi Forel

32. Black; top half of pronotum, whole of epinotum and node red; basal half of mandibles yellow, apical half darker, antennae and tibiae brown, tarsi reddish. Mesonotum longitudinally striate-rugose. Node coarsely and irregularly rugose. Postpetiole finely rugose, the rugae more or less obsolete and longitudinal. 11-11·5 mm. . . . . scabra sp. nov.

33. Head, pronotum, mesonotum and gaster black, epinotum, node and postpetiole light red, mandibles yellow; antennae and legs reddish yellow. Mesonotum longitudinally striate-rugose. Node irregularly rugose. 11-12 mm. . . . . occidentalis sp. nov.

34. Black; mandibles yellow, antennae and legs brown, tarsi reddish-brown. Mesonotum longitudinally striate-rugose. Node coarsely rugose. 10-11 mm. . . . . celaena sp. nov.

35. Black; dorsum and sides of pronotum, epinotum and node red; mandibles yellow, funiculus and tibiae brown, tarsi lighter. Mesonotum longitudinally striate-rugose. Node coarsely punctate. Postpetiole superficially punctate-rugose, the punctures large and shallow. 10-11 mm. . . . . maloni sp. nov.

36. Head, postpetiole and gaster black, a large reddish patch at each side of postpetiole, thorax and node bright red, mandibles and antennae yellow, legs reddish-yellow. Mesonotum longitudinally striate. Node circularly rugose. 13-14·5 mm. .. .. elegans sp. nov.

37. Black; dorsum of epinotum, node and in parts the postpetiole blood-red; mandibles yellow; antennae and legs reddish-brown. Mesonotum longitudinally striate-rugose. 11-11·5 mm. .. .. opaca sp. nov.

38. External borders of mandibles convex 42

39. Head and thorax striate 41

40. Head and gaster black; antennae, thorax, node, postpetiole, a small patch on each side of first segment of gaster and all the legs yellowish-red, mandibles yellow. Mesonotum finely striate longitudinally, diverging outward in front. Node striate-rugose circularly. 13-14·5 mm. .. .. cephalotes sp. nov.

41. Reddish-yellow, head and last two segments of gaster black. Mesonotum finely striate longitudinally, striae obsolete behind. Node circularly striate. 14·5 mm. .. .. hilli sp. nov.

42. Head black; antennae, thorax, nodes and gaster yellowish-red; mandibles and legs yellow; base of scapes, anterior edge of pronotum and a spot on each side of mesonotum brown. Mesonotum very finely and densely punctate-reticulate. Node circularly striate-rugose. 12·5-14 mm. .. .. callima sp. nov.

43. External borders of mandibles concave, teeth hook-shaped 48

44. Head and thorax finely striate rugose.

45. Black; node and postpetiole red, mandibles and basal half of scapes yellowish-brown, apical half of scapes, funiculus and legs yellowish-red. Mesonotum finely striate-rugose longitudinally. Node irregularly rugose. 11-12·5 mm. .. .. varians Mayr

46. Yellowish-red, head and gaster black; mandibles, labrum and apex of clypeus yellow. Mesonotum finely striate-rugose longitudinally. Node irregularly rugose. 12·5-14 mm. wilsoni sp. nov.

47. Head and gaster blackish-brown; thorax, node, postpetiole and all legs reddish-yellow; mandibles, anterior edge of clypeus, labrum and antennae yellow. Mesonotum longitudinally striate. Node circularly rugose. 10-11 mm. .. .. shepherdi sp. nov.

48. Black; node red, epinotum reddish on some examples; mandibles, antennae and legs brown; tarsi reddish. Mesonotum finely striate-rugose longitudinally. Node irregularly rugose. 10·5-14 mm. .. .. goudiei sp. nov.
49. Teeth sawtooth-shaped 55
50. Blackish-brown; mandibles, antennae and legs brown. Three apical segments of gaster with long and abundant golden yellow pubescence. Mesonotum finely and closely striate longitudinally. Node irregularly, almost circularly rugose. 10·5-12 mm. .. .. tepperi Emery
51. Black, mandibles yellow, funiculi and legs blackish-brown, tarsi lighter. Mesonotum strongly striate longitudinally. Node striate-rugose. 11-13 mm. .. .. clarki Crawley
52. Head, postpetiole and gaster black; thorax and node bright red, basal half of mandibles yellow, apical half reddish-yellow, antennae and legs brown, scapes darker. Mesonotum irregularly rugose, somewhat longitudinally. Node circularly rugose. 11-12·5 mm. .. .. swalei Crawley
53. Head and gaster black; thorax and node reddish-yellow; postpetiole generally with a large reddish spot on each side in front; mandibles, antennae and legs yellow, apex of mandibles and base of scapes brown. Mesonotum longitudinally striate. Node coarsely punctate-rugose. 10-11 mm. .. .. testaceipes sp. nov.
54. Head and gaster black; mandibles yellow; antennae, thorax, nodes and legs brownish-red, base of scapes darker. Mesonotum longitudinally striate-rugose. Node coarsely punctate-rugose. 9·5-10·5 mm. .. .. dixoni sp. nov.
55. Black; mandibles, antennae and legs brown, tarsi lighter. Mesonotum longitudinally striate-rugose. Node irregularly and coarsely punctate-rugose. 9·5-15 mm. .. .. gilberti Forel
56. External border of mandibles straight or feebly convex, teeth on basal half obsolete and sawtooth-shaped 66
57. Black; mandibles, antennae and legs brown, tarsi reddish; on some examples the mandibles and legs quite reddish. Pubescence on gaster bright golden-red, long and abundant. Mesonotum and node longitudinally striate-rugose. Postpetiole finely striate-rugose in front, punctate-rugose behind, appearing as elongate punctures. 12-15 mm. .. .. mandibularis Smith
58. Black; mandibles, antennae and legs reddish-brown. Mesonotum coarsely striate longitudinally. Node coarsely and irregularly rugose. Postpetiole and gaster microscopi-

	cally punctate. Pubescence reddish in middle, golden on sides of first segment. 11-14 mm.	laevinodis sp. nov.
59.	Black, mandibles, antennae and legs dark brown, tarsi reddish. Mesonotum and node longitudinally striate-rugose. Pubescence on postpetiole and gaster brass yellow. 10-15·5 mm.	piliventris Smith
60.	Black; mandibles, antennae, tibiae and tarsi reddish-brown; coxae and femora yellowish-red. Mesonotum longitudinally and coarsely striate. Node coarsely and irregularly rugose. Pubescence on postpetiole and gaster brass yellow. 12-16 mm.	femorata Santschi
61.	Head, thorax and node brownish-black, postpetiole and gaster brown; mandibles, antennae and legs reddish-brown. Mesonotum coarsely striate longitudinally. Node coarsely and irregularly rugose. Pubescence on postpetiole and gaster golden, dense, hiding the sculpture. 9·5 mm.	rectidens Forel
62.	Black; mandibles and antennae brown, coxae and legs reddish-yellow, tarsi slightly darker. Mesonotum and node coarsely striate-rugose, more or less longitudinal. Pubescence on posterior third of postpetiole greyish-yellow, long and abundant, pubescence on gaster brass yellow, forming a dense covering. 10-12 mm.	fulvipes Roger
*63.	Black; mandibles and antennae red, legs reddish-yellow. Mesonotum and node rugose. Pubescence on postpetiole and gaster dense, greenish-golden. 12-14·5 mm.	barbata Wheeler
*64.	Head, thorax and petiole blackish-red; mandibles, antennae, legs and gaster red. Mesonotum and node coarsely rugose. Postpetiole sharply rugose longitudinally. Pubescence on gaster coarse and long, bright golden. 13 mm.	coelatinoda Wheeler
65.	Black; mandibles yellow, antennae and legs brown, tarsi reddish. Mesonotum coarsely striate-rugose. Node irregularly punctate-rugose. Pubescence on gaster yellow, forming a dense covering. 12 mm.	luteiforceps Forel
66.	Head, thorax and node black; mandibles and antennae reddish-brown, postpetiole and anterior two-thirds of first segment of gaster brown, apical third of first segment and whole of following segments, legs and coxae reddish-yellow. Mesonotum coarsely rugose longitudinally. Node irregularly rugose. 13-14·5 mm.	fulviculis Forel

*From description only.

Promyrmecia aberrans Forel

Plate XII, fig. 1

Myrmecia aberrans Forel, Ann. Soc. Ent. Belg., xliv, p. 54, 1900, ☿. Rev. Suisse Zool., xviii, p. 9, 1910, ☿.

Myrmecia (*Promyrmecia*) *aberrans* Emery, Genera Insectorum, fasc. 118, p. 19, pl. 1, fig. 10, 1911, ☿.

Worker. Length 12 mm.

Mandibles, clypeus and antennae reddish-yellow; head, mesonotum, sides of thorax, postpetiole and gaster black, dorsum of pronotum and epinotum and whole of node bright red; legs, including coxae brown, tarsi reddish-brown.

Shining. Mandibles coarsely and obliquely striate. Head longitudinally striate in front, the striae diverging outward behind and almost contouring the eyes, more punctate-rugose behind at occipital border, clypeus longitudinally rugose. Pronotum with some obsolete longitudinal striae in middle, transverse in front, almost smooth at sides, numerous large shallow punctures. Mesonotum smooth in middle, some obsolete longitudinal striae at sides, punctate as on pronotum. Epinotum coarsely striate-rugose transversely. Node irregularly rugose, the rugae obsolete in middle. Postpetiole, gaster and all the body densely and very finely punctate.

Hair yellow, short, erect, abundant throughout, shorter and suberect on antennae and legs. Pubescence white, very fine, and adpressed, forming a distinct covering on postpetiole and gaster but not hiding the sculpture.

Head as long as broad, sides straight, occipital border concave at middle, angles broadly rounded. Mandibles about one-third shorter than head, apical two-thirds convex; inner border almost straight to basal fourth, then abruptly reduced to base, furnished with nine short, broad teeth, the ninth forming the basal angle. Scapes as long as mandibles, not reaching the occipital border by twice their width at apex; second segment of funiculus one-twelfth longer than first, third equal to first. Thorax twice as broad as long; pronotum twice as broad as long, sides and front strongly convex, dorsum flat or feebly convex; mesonotum as long as pronotum, one-sixth broader than long, convex in all directions, excision deep and narrow; epinotum one-fifth longer than broad, feebly convex transversely; in profile mesonotum higher than pronotum and epinotum, epinotal excision deep and narrow; pronotum evenly convex from apex to base, mesonotum convex, highest in front of middle, dropping behind; dorsum of epinotum feebly convex broadly rounded into declivity. Node one-sixth broader than long, slightly broader behind than in front, convex in all directions; in profile higher than long, anterior and posterior faces straight and vertical, dorsum feebly convex, borders rounded; ventral spine translucent, broader than long, bluntly pointed. Postpetiole twice as broad as long, almost hemispherical, constriction wide. First segment of gaster broader than long, broader behind than in front. Legs robust.

Male and female unknown.

Habitat.—South Australia: Gawlertown (type locality); Wilpena Pound (H. M. Hale).

Distinguished by the black mesonotum on the bright red thorax.

Wheeler has described several subspecies of *aberrans*. It is, however, evident that the species he regarded as *aberrans* is the Victorian species which I had confused with that species previously. As the various forms are not represented in our collections the descriptions of these are given entirely from his work.

The subspecies *maura* Wheeler is regarded as a valid species. Workers and females are not uncommon.

The following forms described by Wheeler are not represented in our collections, but for the sake of completeness his descriptions are included.

Promyrmecia aberrans Forel s.sp. *formosa* Wheeler.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *formosa* Wheeler, Colony-founding among Ants, 1933, p. 52, fig. 19.

Length 10-13 mm.

Head, thorax and petiole blood-red, with the following black markings: a large chevron, extending across the front between the inner orbits, with its point extending backward and covering the ocellar triangle, but leaving the clypeus and the space between the frontal carinae red, posterior portion of gula, neck, pleurae, posterior borders of pronotum and epinotum, peduncle of petiole and in some specimens a median spot on the mesonotum. Mandibles and antennae reddish-yellow; gaster and legs black, sting and four apical joints of tarsi reddish-brown. Posterior corners and sides of head very smooth and shining, sparsely and coarsely punctate. Mesonotum coarsely punctate, longitudinally or obliquely, in some specimens more feebly or more concentrically, rugose. Epinotum and petiole sculptured as in the typical *aberrans*. Postpetiole and gaster very smooth and shining, with fine greyish pubescence only on the sides and posterior borders of the segments. Legs less shining and very finely pubescent.

Described from thirteen specimens taken at Uralla, New South Wales (Wheeler).

Promyrmecia aberrans Forel s.sp. *haematosticta* Wheeler.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *haematosticta* Wheeler, Colony-founding among Ants, 1933, p. 51.

Length 10-13 mm.

Coloured like *maura*, but with a large spot behind each eye, one on the disk of the pronotum and the upper surface of the petiolar node, except for a median longitudinal black streak, blood-red. Femora black; mandibles and antennae distinctly darker than in *maura* and more reddish. Mesonotal rugae less pronounced and in two specimens oblique, or asymmetrical. Petiole smoother, varying from coarsely punctate, without distinct rugae, to loosely rugose-punctate. Postpetiole fully one and two-thirds times as broad as long.

Described from three specimens taken at Uralla, New South Wales (Wheeler).

Promyrmecia aberrans Forel s.sp. *sericata* Wheeler.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *sericata* Wheeler, Colony-founding among Ants, 1933, p. 53.

Length 14 mm.

Like *taylori* in coloration. Sculpture less pronounced, the rugae on the head and pronotum coarse but rounded and interspersed with large, elongate punctures. Mesonotum coarsely punctate, with only indistinct traces of fine transverse rugules. Epinotum anteriorly indistinctly rugose, petiole more coarsely and distinctly, the node of the latter broader than long, the postpetiole nearly as broad as in *taylori*, and the pilosity, which is whitish, as long and abundant. Appressed pubescence on the gaster and postpetiole golden yellow, decidedly longer and converging from each side to the middle line at the posterior border of each segment.

Described from a single specimen taken by W. W. Froggatt at Wagga, New South Wales. Another specimen, perhaps to be regarded as representing a distinct variety of *sericata*, from Meningie, South Australia (L. H. Minchin), measures only 12 mm. and has the mesonotum coarsely, transversely and arcuately rugose with large interspersed punctures and the petiolar node longer and more coarsely rugose.

Promyrmecia aberrans Forel s.sp. *taylori* Wheeler.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *taylori* Wheeler, Colony-founding among Ants, 1933, p. 53.

Length 15 mm.

Larger than *froggatti* but similarly coloured; body somewhat more opaque; the rugae strong on the head and thorax but less sharp than in the preceding forms, arcuate and transverse on the mesonotum, reticulate on the epinotum and petiole. Node of the latter more sharply cuboidal than in *froggatti*, postpetiole nearly twice as broad as long, like the gaster subopaque and finely punctate, with longer and denser, yellowish pubescence. Pilosity on the body longer and more abundant than in the preceding forms.

Described from a single specimen taken by Frank H. Taylor in the Roma District, Queensland.

Promyrmecia maura Wheeler.

Plate XII, figs. 6-7.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *maura* Wheeler, Colony-founding among Ants, p. 51, 1933, ☿.

Worker. Length 11-13 mm.

Black; mandibles, antennae and tarsi reddish-yellow, teeth of mandibles blackish-brown, articulations of legs reddish-brown.

Shining. Mandibles obliquely and coarsely striate. Head finely striate longitudinally. Pronotum and mesonotum longitudinally striate, coarser than on head. Epinotum more coarsely striate-rugose transversely, interstices densely reticulate. Node irregularly punctate-rugose, almost circularly rugose. Postpetiole and gaster densely and microscopically punctate.

Hair yellowish, sparse, short and erect, longer on clypeus and apex of gaster. Pubescence greyish, sparse throughout.

Head very slightly broader than long, as broad in front as behind, sides fully convex, occipital border deeply concave at middle, angles broadly rounded. Mandibles fully their width shorter than head; external border straight or feebly concave at middle, inner border straight to basal fourth then abruptly reduced to base, furnished with nine large broad teeth, first two smallest, ninth forms an angle between the two apparent borders. Scapes not extending to occipital border by fully twice their thickness; second segment of funiculus as long as first; third slightly shorter. Thorax twice as long as broad; pronotum twice as broad as long, sides and front convex, dorsum flattened; mesonotum as long as pronotum, almost one-third broader than long, convex in all directions; excision deep and narrow; epinotum one-third longer than broad, convex transversely; in profile evenly convex from apex of pronotum to base of mesonotum, a very slight depression at pro-mesonotal suture, meso-epinotal excision deep and narrow; epinotum convex from base to foot of declivity. Node one-fifth broader than long, sides strongly convex, anterior and posterior borders feebly convex; in profile one-fifth higher than long, anterior and posterior faces straight, vertical, both bluntly rounded into the slightly convex dorsum, ventral spine broad, triangular, bluntly pointed. Post-

petiole barely one and one-half times broader than long, hemispherical in front; constriction wide but not deep. First segment of gaster one-fifth broader than long. Legs short and robust.

Female. Length 14-16 mm.

Larger and more robust than the worker, colour identical, sculpture similar but coarser; pilosity longer and more abundant. Scutellum small, feebly impressed, about one-fifth of the length of mesonotum.

Habitat.—New South Wales: Tarcutta; Gundagai (J. Clark); Canberra (G. F. Hill, T. Greaves); Red Hill (T. Greaves); Monaro (N. R. Flynn).

Promyrmecia froggatti Forel

Plate XII, fig. 5

Myrmecia froggatti Forel, Rev. Suisse Zool., xviii, p. 9, 1910, ☿.

Myrmecia (*Promyrmecia*) *froggatti* Emery, Genera Insect., fasc. 118, p. 19, 1911, ☿.

Myrmecia (*Promyrmecia*) *aberrans* Forel s.sp. *froggatti* Forel,Wheeler, Colony-founding among Ants, p. 52, 1933, ☿.

Worker. Length 11-12 mm.

Dark red; postpetiole and gaster black; front of face and the legs brownish-black; mandibles, antennae and tarsi yellow.

Shining. Head longitudinally striate-reticulate, the striae straight on middle of head, slightly diverging outward at sides, and continued into the antennal depressions. Some large punctures on occipital border. Mandibles strongly and obliquely striate. Pronotum longitudinally and strongly striate. Mesonotum and epinotum transversely striate, continued obliquely on the sides. Node coarsely reticulate. Postpetiole and gaster very finely punctate.

Hair yellowish, erect, rather sparse throughout. Pubescence greyish, very fine and adpressed, most abundant on postpetiole and gaster.

Head broader than long, as broad in front as behind, occipital border concave, posterior angles rounded. Mandibles short and broad, external border concave at middle; inner border nearly straight to basal third, furnished with eleven teeth, the first two small, the third, fifth, ninth and tenth large and blunt; the ninth forms the angle between the two apparent borders. Frontal carinae erect, nearly straight, extending to posterior margin of eyes. Scapes not extending to occipital border by one-fifth of their length; first segment of funiculus as long as second. Thorax fully twice as long as broad; pronotum twice as broad as long, broader in front than behind, dorsum flattened in middle. Mesonotum slightly broader than long, convex and rounded above. Epinotum one and three-fourths times longer than broad, strongly arched from basal to inferior posterior edge; the declivity not defined. Node as broad as long, broader behind than in front, in profile higher than long, rounded above, the stalk in front extremely short. Postpetiole one and one-third times broader than long. First segment of gaster slightly broader than long, almost as broad behind as in front, sides convex. Legs moderately long and stout.

Male and female unknown.

Habitat.—New South Wales: Manilla (W. W. Froggatt); Quirindi (Col. C. V. Morissett).

Re-described from a co-type received from the late Mr. W. W. Froggatt.

This is close to *P. aberrans,* as noted by Forel, but is distinct.

The sculpture is larger and coarser, the head and node differently shaped, the pubescence much more abundant. In both the postpetiole and gaster have fine microscopic punctures often obscured by pubescence, both segments are more shining in *froggatti* than in *aberrans*. The clypeus is much more excised and the clypeal projections more outwardly directed in *froggatti*, and the labrum shorter and narrower, nearly square, not rounded as in *aberrans*.

Promyrmecia nobilis sp. nov

Plate XII, figs. 2-4

Myrmecia (*Promyrmecia*) *aberrans* Forel, Clark, Victorian Naturalist, xlii (6), p. 136, 140, 1925, ☿. Wheeler, Colony-founding among Ants, p. 50, 1933, ☿. Clark, Mem. Nat. Mus. Vict., viii, p. 9, pl. 1, figs. 1, 2, 1934, ☿ ♀ ♂.

Worker. Length 10-14 mm.

Black; top of pronotum, mesonotum, epinotum and node, red; mandibles and labrum yellowish-red, points of teeth black; antennae and tarsi brownish. Some examples have a reddish tinge on lateral borders of the head behind.

Shining. Head longitudinally striate in middle, the striae between frontal carinae continued from front of clypeus to occipital border; sides of clypeus and antennal depressions not striate, but finely and densely punctate, these fine punctures continued between the striae on head; some large scattered punctures on occipital border. Pronotum longitudinally striate in middle, longitudinally arched at sides above: mesonotum smooth and shining, with some scattered shallow punctures; there are faint traces of fine longitudinal striae on some examples. Epinotum coarsely striate transversely, descending obliquely on the sides; node circularly striate, with a central longitudinal carina; postpetiole, gaster, scapes and legs very finely and densely punctate.

Hair yellowish, sparse on head and body, more abundant on the apical segments of gaster, but short and erect; shorter and adpressed on the tibia and tarsi, tibia also furnished with some long bristle-like hairs on the underside. Pubescence greyish, very fine and adpressed on clypeus and funiculus; more abundant on postpetiole and gaster, shorter and finer on sides of thorax.

Head very slightly broader than long, broader behind than in front, occipital border concave, angles broadly rounded. Mandibles short and broad, not as long as head, external border feebly concave at middle; inner border nearly straight to basal third, thence strongly reduced to base; furnished with twelve teeth, first two small, third, fifth, seventh, eighth, tenth and eleventh strong and obtuse; the tenth forms the angle between the two apparent borders. Frontal carinae short, extending to about the posterior third of eyes. Clypeus strongly excised at middle in front, the excision obtuse, sides straight, forming a sharp tooth-like projection on each side. Labrum sharply rounded, projecting outward almost to the points of clypeus. Scapes not extending to occipital border by one-fifth their length; first and second segments of funiculus equal, third somewhat shorter, apical as long as the two preceding combined. Thorax twice as long as broad. Pronotum one and one-half times broader than long, broader in front than behind, slightly depressed above. Mesonotum almost circular, very slightly broader than long, convex and rounded above. Epinotum one and one-fifth times longer than broad; in profile the dorsum and declivity appear as an even arch. Node circular, as broad as long and as broad in front as behind; the stalk in front very short, barely

one-third of the length of node; in profile a little higher than long, rounded above, anterior and posterior faces vertical. Postpetiole one and one-half times broader than long, broadest at middle. First segment of gaster broader than long, and broader behind than in front. Legs moderately long.

Female. Length 16-18 mm.

Colour identical with worker. Sculpture slightly coarser. Pilosity similar.

Apart from the great size and bulk it closely resembles the worker. The scutellum is very small and inconspicuous. The metanotum is indicated by a sharp ridge. There are no traces of wings, but the anterior wing sclerites are indicated.

Male. Length 13-14 mm.

Black. Antennal scapes and first segment of funiculus, femora of all legs, and anterior tibiae and apical segments of tarsi, red; middle and posterior tibiae brownish.

Mandibles shining, finely punctate. Head finely reticulate, coarser behind, with some large shallow punctures. Pronotum similar. Mesonotum similar in front. Epinotum with coarse reticulations forming faint transverse rugae. Node irregularly rugulose, with a strong longitudinal central carina. Postpetiole and gaster finely and densely punctate.

Hair yellow, erect, long and abundant except on antennae and legs. Pubescence white, very fine, short and adpressed, particularly abundant on gaster.

Head broader than long, broader in front than behind, sides strongly convex, occipital border short and straight. Mandibles short, not raised. Scapes fully twice as long as first segment of funiculus; second segment four times as long as first. Pronotum short, strongly convex. Mesonotum convex in front, flattened behind, mayrian furrows distinct but not strongly impressed; parapsidal furrows sharply defined. Scutellum strongly convex above, twice as broad as long. Epinotum twice as broad as long, strongly convex. Node slightly broader than long, sides strongly convex. First segment of gaster much broader behind than in front. Legs slender. Genitalia retracted.

Habitat.—Victoria: Altona (J. E. Dixon, ☿; T. Greaves, ☿ ♀ ♂; J. Clark, ☿ ♀ ♂); Bacchus Marsh and Coburg (C. Oke, ☿ ♀); Broadmeadows (F. P. Spry, ☿); Geelong (A. D. Butcher, ♀); Patho (H. Potter).

Winged females have not been seen in any of the nests examined. All the females found are similar to the worker and apart from their greater size are easily overlooked. Ergatoid females occur with several species of the genus, but winged forms also are known with the majority.

This species has been confounded with *aberrans* Forel, from which it differs in the formation of the head and nodes. The colour and sculpture also are different.

The various subspecies erected by Wheeler are based on this species, not on *aberrans,* which apparently he did not know.

Promyrmecia eupoecila sp. nov.

Plate XII, fig. 8.

Female. Length 14·5 mm.

Mandibles and antennae yellow, head yellowish-red with a broad brown band across the forehead, extending from eye to eye and including the ocelli; pronotum

and node bright red, mesonotum and epinotum reddish-brown, postpetiole and gaster black, legs brown, tarsi reddish.

Mandibles coarsely striate obliquely, the striae very large. Head longitudinally striate, some large shallow punctures between the striae. Pronotum and mesonotum longitudinally striate-rugose, coarser than on head. Epinotum and node coarsely and irregularly rugose, transverse on declivity. Postpetiole, gaster and all the body densely and very finely reticulate-punctate.

Hair yellow, long, erect and abundant throughout, short and suberect on antennae and legs. Pubescence yellow, very fine and adpressed, forming a distinct covering on postpetiole and gaster but not hiding the sculpture.

Head a fraction broader than long, sides convex, angles very broadly rounded, occipital border deeply indented at middle. Mandibles one-fourth shorter than head, as long as scapes, apical half of external border convex, inner border straight, furnished with eight large, broad, blunt teeth, the eighth forms the basal angle. Scapes not reaching the occipital border by fully twice their width at apex; first and second segments of funiculus equal length, third one-fourth shorter. Thorax fully twice as long as broad. Pronotum three times broader than long, sides strongly convex, dorsum feebly convex. Mesonotum twice as long as pronotum, one-seventh broader than long, strongly convex in all directions. Scutellum very small, twice as broad as long, appearing as if embedded in mesonotum, excision deep and wide; metanotum small but prominent; epinotum longer than broad, feebly convex transversely; in profile centre of mesonotum slightly higher than pronotum and epinotum, excision deep. Pronotum high, strongly convex. Mesonotum convex, highest at middle, dropping behind; scutellum small, just apparent in epinotal excision; epinotum raised in front, convex from base to bottom of declivity. Node one-seventh broader than long, broadest at middle, broader behind than in front; in profile higher than long, anterior face high, slightly convex, posterior face straight, both faces rounded into the feebly convex dorsum, ventral spine short, broad and sharp-pointed. Postpetiole fully one and one-half times broader than long, broadest just behind middle, strongly convex in all directions, constriction deep and narrow. First segment of gaster broader than long, broader behind than in front, sides strongly convex. Leg robust.

Male and worker unknown.

Habitat.—South Australia: Adelaide (R. Blackwood, 25.8.27).

The structure of the thorax and nodes as well as the variegated colour render this species very distinct.

Promyrmecia greavesi sp. nov.

Plate XII, fig. 9.

Female. Length 15·5 mm.

Head, thorax and node red, mandibles and antennae testaceous, legs brown, gaster black.

Mandibles strongly and coarsely striate diagonally and a long straight striae at base of teeth, base punctate only. Head finely striate-rugose longitudinally, very finely and densely punctate between the rugae. Pronotum striate-rugose similar to head. Mesonotum coarsely and irregularly punctate-rugose. Metanotum shining. Epinotum very coarsely rugose, somewhat transverse on the declivity. Node irregularly rugose with a central longitudinal carina. Postpetiole and gaster microscopically punctate.

Hair yellow, short and erect on head, antennae, thorax, nodes and legs, long and fine on gaster, longer and coarser on mandibles and clypeus.

Head as broad as long, sides strongly rounded into occipital border; occipital border deeply indented, concave at middle. Mandibles one-third shorter than head, external border straight, inner border furnished with eight large sharp teeth, the eighth forming the basal angle, there is one strong tooth on basal border. Clypeus projecting strongly in front, angles sharp, deeply excised in middle, sides straight. Frontal carinae as long as broad behind. Scapes extend to posterior fourth of head; first segment of funiculus one-fifth longer than second, remainder decreasing in length to apical which is barely as long as the two preceding combined. Thorax twice as long as broad. Pronotum fully twice as broad as long, strongly convex in front and on sides, flattened above. Mesonotum circular, very slightly broader than long. Scutellum small and narrow, no traces of wing stumps. Metanotum small and erect. Epinotum as long as broad, convex laterally. In profile the pronotum evenly arched from base to apex, mesonotum raised, highest in front, convex, scutellum and metanotum small, epinotum strongly convex from base to apex. Node as long as broad, circular, flattened on top, a weak longitudinal carina in the centre. In profile as high as long, anterior and posterior faces straight, vertical, both rounded into the feebly convex dorsum; the ventral spine broad, short and sharp-pointed. Postpetiole barely twice as broad as long, strongly convex in all directions. First segment of gaster broader than long, broadest behind, sides strongly convex. Legs long and robust.

Worker and male unknown.

Habitat.—North Queensland: Mareeba (T. Greaves).

The peculiar colour and sculpture render this species distinct from all the other known species.

Promyrmecia picta Smith

Plate XII, figs. 10-13

Myrmecia picta Smith, Cat. Hym. Brit. Mus., vi, p. 146, 1858, ☿. Lowne, The Entomologist, Long., ii, p. 336, 1865, ☿.

Myrmecia (*Myrmecia*) *picta* Smith, Emery, Genera Insect., fasc. 118, p. 21, 1911.

Myrmecia (*Promyrmecia*) *picta* Smith; Clark, Victorian Naturalist, xliv (2), p. 39, 1927, ☿ ♀ ♂; Mem. Nat. Mus. Vict., viii, p. 11, pl. 1, figs. 3, 4, 1934, ☿ ♀ ♂.

Worker. Length 9-12 mm.

Black. Mandibles, clypeus, front of face, to about the posterior margin of eyes, yellow; antennae and anterior legs reddish-yellow; intermediate and posterior legs brownish; tarsi lighter. The colour of the thorax and nodes is most variable, ranging from all black on some specimens, to all red on others. The most numerous individuals have the head, behind the eyes, pronotum and a spot on mesonotum, black; edges of mesonotum, all the epinotum, node and a greater portion of postpetiole red, or reddish-yellow. The gaster always black.

Head longitudinally striate, finely and densely reticulate between the striae. Mandibles shining, with scattered elongate punctures. Pronotum transversely arched striate-rugose, in some specimens almost longitudinally arched. Mesonotum finely rugose transversely, on a few examples almost smooth. Epinotum transversely, often irregularly, rugose, definitely striate on declivity. Node irregularly rugose. Postpetiole and gaster very finely and densely punctate.

Hair yellowish, erect, rather long and abundant throughout, none on scapes, longer and more abundant on apical segments of gaster than elsewhere. Pubescence

greyish, very fine and abundant, particularly on postpetiole and gaster, frequently appearing as a greyish covering.

Head as long as broad, broader in front than behind, occipital border nearly straight, angles rounded. Mandibles not as long as head, external border concave at middle, inner border nearly straight to basal fifth, thence sharply reduced to base, furnished with nine teeth, first two small, third, fifth, seventh and ninth twice as large, the ninth forms the angle between the two apparent borders. In some examples there is indication of a tooth on basal border but this is usually edentate. Frontal carinae short, almost parallel. Clypeus strongly excised in front, inner edges straight. Labrum projecting almost to points of clypeus, anterior border feebly rounded. Scapes not extending to occipital border; second segment of funiculus one-third longer than first and third, fourth to eighth equal, ninth and tenth shorter, apical as long as the two preceding combined. Thorax fully two and one-half times as long as broad. Pronotum almost twice as broad as long, dorsal surface slightly rounded. Mesonotum circular, rounded above. Epinotum longer than broad, without a boundary between dorsum and declivity, the latter short. Node broader than long, slightly broader behind than in front; in profile much higher than long, rounded above, the stalk in front short, not half the length of node, anterior face nearly vertical, posterior face sloping behind. Postpetiole one and three-fourths times broader than long, much broader behind than in front, convex on sides and above. First segment of gaster broader than long. Legs long and moderately slender.

Female. Length 13·5-14·5 mm.

Differs from the worker only by larger size and in possessing wings. The colour appears to be more constant. In all the examples examined the occiput, pronotum, margins of the other segments and gaster are blackish; the mesonotum, scutellum, epinotum, node and postpetiole red. All the legs are uniformly castaneous, except the apical half of posterior femora, these are brown. Front of face bright yellow. Four corners of node more clearly defined, but not sharp. Wings hyaline. Ergatoid females also are present.

Male. Length 10-11 mm.

Black; mandibles, five basal segments of antennae, front of face and all the legs, yellow; eight apical segments of antennae brown.

Head finely striate-rugose on middle, becoming coarser at lateral and occipital borders. Mandibles shining, coarsely and sparsely punctate. Pronotum, scutellum, mesonotum and epinotum coarsely reticulate-punctate. Node coarsely and irregularly rugose. Postpetiole and gaster very finely and densely punctate.

Hair greyish, long and suberect, longer and more abundant on head and thorax than on gaster, short and adpressed on legs, none on antennae. Pubescence greyish, short, most abundant on gaster.

Head broader than long, broader in front than behind; occipital border convex. Mandibles short, triangular, external border convex; diverging behind. Clypeus long, convex and rounded above, concave at middle in front. Antennae long and slender; scapes short, first segment of funiculus half as long as scapes, second three and one-half times as long as scapes, third slightly shorter than second, the others about equal. Thorax barely twice as long as broad. Pronotum strongly rounded in front and above. Mesonotum large, convex and rounded above, mayrian furrows distinct; a deep longitudinal suture extends from anterior border to near base; parapsidal furrows faintly defined. Scutellum broad, strongly convex. Epinotum strongly convex and rounded above, without a boundary between the dorsum and declivity. Node slightly broader than long, almost circular, strongly convex above. Postpetiole broader than long, broadest just behind the middle,

strongly convex above and on sides. First segment of gaster broader than long. Legs long and robust.

Habitat.—Western Australia: Merriden (L. J. Newman); National Park and Mundaring (J. Clark); Yellowdine (W. Joyce).

South Australia: Adelaide; Mt. Lofty (A. H. Elston); Port Lincoln (F. E. Wilson).

Victoria: Maldon (J. C. Goudie); Mallee (J. E. Dixon); Wyperfield (J. Clark).

New South Wales: Broken Hill (F. W. Shepherd); Narrabri (W. W. Froggatt).

The colour varies considerably in the individuals of a single colony. Many specimens are entirely black, with the exception of mandibles, front of face, antennae and anterior legs. Others have thorax, petiole and anterior half of postpetiole entirely red or variously marked with red. The extent of yellow area on front of face also varies slightly, on some examples this does not pass anterior margin of eyes, whilst on others it extends well beyond posterior margin. Although the colour varies considerably, the sculpture, pilosity and pubescence are constant. The same colour varieties occur in all colonies obtained from each State.

Promyrmecia fucosa Clark.

Plate XII, figs. 14-16.

Myrmecia (*Promyrmecia*) *fucosa* Clark, Mem. Nat. Mus. Vict., viii, p. 15, pl. 1, figs. 5, 6, 1934, ☿ ♀.

Worker. Length 10-11·5 mm.

Red. Posterior half of head and two apical segments of gaster black. Mandibles and front of face to about the middle of eyes yellow; antennae and anterior legs testaceous; middle and posterior legs brownish.

Head longitudinally and irregularly rugose, densely and finely reticulate between the rugae. Mandibles smooth and shining, with some scattered shallow punctures. Pronotum transversely arched-rugose. Mesonotum finely striate transversely. Epinotum transversely striate-rugose, coarser than on mesonotum but not as coarse as on pronotum. Node strongly and irregularly rugose. Postpetiole and gaster very finely and densely punctate.

Hair greyish, long and erect, abundant on whole body, except the scapes, shorter and suberect on funiculus and legs. Pubescence greyish, long and abundant on postpetiole and gaster, forming a distinct covering, sometimes hiding the sculpture; sparse elsewhere.

Head slightly longer than broad, broadest in front, occipital border feebly concave, angles rounded. Mandibles not as long as head; external border almost straight to apical third; inner border nearly straight to basal third, then greatly reduced to base; furnished with nine teeth, the third, fifth, seventh, eighth and ninth twice as large as the first two; the eighth forms the angle between the two apparent borders, the ninth placed just in front of middle of basal border. Frontal carinae extending to the posterior margin of eyes. Clypeus obtusely excised at middle in front; anterior corners produced as blunt tooth-like angles. Labrum broadly rounded, extending outward to apex of clypeus. Scapes not extending to the occipital border; first segment of funiculus slightly shorter than second, but longer than tenth. Thorax two and one-half times as long as broad. Pronotum broader than long. Epinotum about one and one-half times as long as broad. Boundary

between the dorsum and declivity feebly indicated. Node as long as broad, slightly broader behind than in front; in profile slightly longer than high, nearly flat above, anterior face vertical, posterior face descending in a gradual slope; the stalk in front not quite half the length of node; postpetiole very slightly broader than long, much broader behind than in front. First segment of gaster as broad as long, slightly broader behind than in front. Legs moderately long and slender.

Female. Length 11-13 mm.

Resembles the worker, but much larger and winged. The sculpture slightly coarser on head, thorax and node. The colour similar, except that on two females examined the scutellum and sides of the mesonotum are brown or blackish.

Male. Length 9 mm.

Head and thorax yellowish-red; mandibles, antennae, nodes, gaster and legs testaceous.

Head finely rugose, the rugae longitudinal, diverging outward behind. Mandibles smooth and shining. Pronotum, epinotum transversely rugose. Scutellum and mesonotum irregularly rugose; node circularly rugose. Postpetiole and gaster very finely and densely punctate, with a few large shallow punctures.

Hair yellow, short and erect on head, thorax and nodes, longer and more abundant on gaster. Pubescence very abundant on gaster, whitish, short and adpressed.

Head broader than long, strongly convex behind the eyes. Mandibles short, sharply pointed, furnished with one large sharp tooth midway between the point and inner angle, clypeus broadly rounded in front. Frontal carinae as long as broad behind, with a feeble median groove between them. Scape of antenna fully as broad as long, twice as long as first segment of funiculus, second segment three times as long as first. Thorax almost twice as long as broad. Pronotum short, sides and front strongly convex. Mesonotum as broad as long, mayrian and parapsidal furrows strongly impressed. Scutellum one-fourth broader than long. Epinotum twice as broad as long; in profile pronotum convex, raised abruptly, mesonotum raised and strongly convex, mayrian furrow deeply impressed. Scutellum dome-shaped; epinotum convex to bottom of declivity. Node one-fifth broader than long, convex in all directions; in profile one-fourth longer than high, anterior face straight and vertical, dorsum feebly convex, rounded into posterior face, the ventral spine long and thorn-like. Postpetiole one and three-quarter times broader than long, sides convex. First segment of gaster much broader than long, broadest behind, sides strongly convex. Legs long and slender.

Habitat.—Victoria: Lake Hattah, Ouyen (J. E. Dixon); Mildura (Mrs. M. J. Zimmer); Sea Lake (J. C. Goudie); Wyperfield (J. Clark).

South Australia: Murray Bridge (A. M. Lea).

This species resembles *P. picta* Smith in size and colour. It is readily distinguished, however, by the form of the mandibles, antennae and nodes.

Promyrmecia urens Lowne

Plate XV, figs. 56-58

Myrmecia urens Lowne, The Entomologist, Lond., ii, p. 336, 1865, ☿.
Myrmecia pumilio Mayr, Verh. Zool. Bot. Ges. Wien, xvi, p. 896, 1866, ☿.
Myrmecia picta Smith, Mayr, Jour. Mus. Godeffroy, xii, p. 94, 1876, ☿; Forel, Ann. Soc. Ent. Belg., xliv, p. 54, 1900, ☿.

Myrmecia (*Myrmecia*) *picta* Emery, Genera Insect., fasc. 118, p. 20, 1911; Viehmeyer, Ent. Mitteil., Berlin, xxiii, p. 222, 1924, ♀.

Myrmecia (*Promyrmecia*) *urens* Clark, Vict. Nat., xliv, p. 39, 1927; Wheeler, Colony-founding among Ants, p. 62, 1933; Clark, Mem. Nat. Mus. Vict., viii, pp. 13-14, 1934.

Worker. Length 6-8 mm.

Black, basal half of mandibles and labrum yellow, apical half reddish-yellow; antennae, anterior tibiae and apical half of femora and all tarsi reddish or reddish-yellow, other tibiae and femora brown. The colour of the thorax and node varies considerably amongst the individuals in every nest. Large numbers have the dorsum of pronotum, epinotum and node red; head, postpetiole and gaster always black.

Apical half of mandibles obliquely striate, basal half finely reticulate and with numerous large, shallow punctures. Head finely and longitudinally striate, striae widely spaced, interstices densely reticulate. Pronotum irregularly rugose, mesonotum with faint traces of obsolete rugae, epinotum irregularly rugose, with a more or less transverse direction, node irregularly rugose, all the thorax and node very densely reticulate. Postpetiole and gaster microscopically punctate.

Hair yellow, long, erect and abundant, shorter and suberect on legs. Pubescence white, very fine and adpressed, longer and more abundant on postpetiole and gaster but not hiding the sculpture.

Head as long as broad, broadest in front, sides and occipital border feebly convex, angles rounded. Mandibles fully their width at base shorter than head, external border concave, inner border convex, furnished with four large, sharp, erect teeth, each preceded by two smaller teeth, the fourth forms a slight angle, behind which are two small denticles. Scapes fully their width at apex shorter than head; first and second segments of funiculus equal length, third one-fifth shorter. Thorax two and one-half times longer than broad; pronotum one-third broader than long, dorsum feebly convex transversely, mesonotum as long as pronotum, circular, as long as broad, excision deep but not wide, epinotum one-third longer than broad, convex transversely; in profile pronotum evenly convex from apex to base, mesonotum strongly convex, much higher than pronotum and epinotum, highest at middle dropping behind, excision deep; epinotum convex from base to bottom of declivity. Node as long as broad, broadest behind the middle, convex in all directions; in profile slightly higher than long, anterior face straight, sloping backward, sharply rounded into dorsum, posterior face short, convex and continuous with dorsum, ventral spine slender and sharp. Postpetiole one-fourth broader than long, constriction deep. First segment of gaster broader than long, much broader behind than in front. Legs long and slender.

Female. Length 8-9 mm.

Colour, sculpture and pilosity as on the worker. Occipital angles more broadly rounded. Mandibles shorter, broader and the teeth stronger. Scapes slightly shorter. Node one-fourth broader than long. Postpetiole one-third broader than long. Wings hyaline. Ergatoid females are found commonly in nests.

Habitat.—New South Wales: Sydney (type locality); Como; Manilla; Pilliga Scrub; Lismore.

Queensland: Fletcher; Milmerran; Peak Downs.

Victoria: Cann River; Bendigo; Lake Hattah; Portland.

South Australia: Mt. Lofty; Port Lincoln.

Tasmania: Launceston.

Promyrmecia infima Forel

Plate XV, figs. 59-61

Myrmecia picta Smith var. *infima* Forel, Ann. Soc. Ent. Belg., xliv, p. 54, 1900, ☿ ; Fauna Sudwest Austral., i, p. 267, 1907.

Myrmecia (*Myrmecia*) *picta* Smith var. *infima Emery*, Genera Insect., fasc. 118, p. 20, 1911.

Myrmecia (*Promyrmecia*) *infima* Wheeler, Colony-founding among Ants, p. 62, 1933; Clark, Mem. Nat. Mus. Vict., viii, p. 14, 1934.

Worker. Length 6-8 mm.

Head, pronotum, mesonotum, postpetiole and gaster black. Mandibles yellow, apical third darker, clypeus, antennae and legs reddish-yellow, base of scapes darker, epinotum and node red.

Mandibles striate, obliquely at apex, five large, shallow punctures on inner edge of apical half. Head very finely and longitudinally striate-rugose, densely reticulate between rugae. Pronotum circularly rugose. Mesonotum rather coarsely reticulate, without striae or rugae. Epinotum and declivity transversely striate-rugose. Node irregularly rugose. Postpetiole and gaster microscopically reticulate.

Hair yellow, long and erect, abundant throughout, short and suberect on legs. Pubescence greyish, very fine and adpressed, forming a slight covering on postpetiole and gaster but not hiding the sculpture.

Head as long as broad, sides and occipital border feebly convex, angles broadly rounded. Mandibles shorter than head by fully their width at base, external border feebly concave, inner border convex, furnished with five large, sharp, erect teeth each preceded by a smaller tooth. Scapes barely as long as mandibles, not reaching the occipital border by fully their thickness; first and second segments of scapes equal in length, longer than third. Thorax two and one-half times longer than broad, pronotum one-fourth longer than broad, convex in all directions; mesonotum circular, as long as broad, meso-epinotal excision deep and wide; epinotum one-fifth longer than broad, dorsum feebly convex transversely; in profile pronotum evenly convex from apex to base, mesonotum slightly higher than pronotum, highest at middle, convex, excision deep and wide, concave at bottom; dorsum of epinotum straight, declivity slightly convex rounded into dorsum. Node one-eighth broader than long, almost circular; in profile higher than long, almost dome shaped above, ventral spine triangular, short, broader than long, sharp-pointed. Postpetiole twice as broad as long, hemispherical, constriction deep and wide. First segment of gaster one-eighth broader than long. Legs long and slender.

Female. Length 8 mm.

Differs from the worker only in being larger, more robust and winged. The sculpture slightly coarser, the scapes and femora slightly darker.

Male. Length 7-8 mm.

Colour, sculpture and pilosity as on the worker. Head as broad as long, almost circular. Mandibles furnished with three large, sharp teeth behind apex. Second segment of funiculus three times longer than scapes and five times longer than first segment. Thorax twice as long as broad. Pronotum three times as broad as long, strongly convex in all directions; mesonotum one-sixth broader than long, mayrian and parapsidal furrows sharply impressed. Scutellum almost as long as broad, strongly convex, epinotum broader than long, convex transversely. Node very slightly broader than long, broadest behind middle, convex in all directions; in profile slightly higher than long, dome-shaped, ventral spine very short and sharp. Postpetiole one-fifth broader than long, broadest at posterior fourth,

greatly reduced in front; constriction deep. First segment of gaster one-seventh broader than long, broader behind than in front. Legs long and slender.

Habitat.—Western Australia: Perth (type locality, Chase); Fremantle; Rottnest Island (L. Glauert); Albany; Denmark (J. Clark).

Promyrmecia nigra Forel

Plate XV, figs. 62-63

Myrmecia picta Smith var. *nigra* Forel, Fauna Sudwest Austral., i, p. 267, 1907, ☿.

Myrmecia (*Myrmecia*) *picta* Smith var. *nigra* Emery, Genera Insect., fasc. 118, p. 21, 1911.

Myrmecia (*Promyrmecia*) *infima* Forel var. *nigra* Wheeler, Colony-founding among Ants, p. 63, 1933, ☿.

Worker. Length 7-9·5 mm.

Black, apical half of mandibles brown, basal half reddish-yellow; antennae and legs brown, apical half of funiculus and the tarsi reddish. The colour of the thorax and node varies considerably amongst the individuals of each nest. The majority of specimens have the pronotum, epinotum and node more or less marked with red, whilst on many examples these segments are entirely red; the postpetiole and gaster always black.

Apical half of mandibles with five large, deep punctures, basal half finely punctate. Head finely striate-rugose longitudinally, interstices densely reticulate. Pronotum more coarsely striate-rugose, transversely arched; mesonotum finely striate-rugose longitudinally and very densely reticulate; epinotum more coarsely rugose transversely; node irregularly rugose; postpetiole and gaster microscopically punctate.

Hair yellow, long, slender and erect, abundant throughout, shorter and suberect on legs. Pubescence white, very fine and adpressed, abundant throughout, longer on postpetiole and gaster but not hiding sculpture.

Head as long as broad, sides and occipital border feebly convex, angles broadly rounded. Mandibles shorter than head by fully their width at base; external border feebly concave, inner border convex, furnished with ten large, sharp, erect teeth, the second, fourth and ninth smallest. Scapes not extending to occipital border by fully their thickness; second segment of funiculus one-eighth longer than first. Thorax two and one-half times longer than broad; pronotum one-fourth broader than long, mesonotum as long as broad, circular, strongly convex above, meso-epinotal constriction deep and narrow; epinotum one-fifth longer than broad; in profile mesonotum higher than pronotum and epinotum, highest at middle, excision deep; dorsum of epinotum convex, almost twice as long as declivity into which it is broadly rounded. Node one-sixth broader than long, broadest behind, feebly convex in all directions; in profile higher than long, anterior face high, sloping backward and rounded into dorsum, posterior face short, convex continuous with dorsum, ventral spine long, slender and sharp, as long as broad at base. Postpetiole almost one and three-quarter times broader than long, hemispherical in front; constriction deep and wide. First segment of gaster broader than long, broadest behind. Legs long and slender.

Female. Length 9·5-11 mm.

Colour as on the worker. Sculpture coarser. Pilosity and pubescence longer and more abundant. Differs from the worker in being larger and more robust and possessing wing.

Male. Unknown.

Habitat.—Western Australia: Perth (type locality); widely distributed and abundant from Albany to Geraldton.

The colour of the thorax and node varies from all black on some individuals to almost all red on others. The same series of colour variations occur in all nests.

Promyrmecia rubicunda sp. nov.

Plate XV, fig. 65

Worker. Length 5·5-6·5 mm.

Head, pronotum, mesonotum and gaster black, mandibles and labrum yellow, funiculus, epinotum, node, postpetiole and all legs reddish-yellow, scapes brown.

Mandibles smooth and shining, with six large, shallow punctures on apical half at base of teeth. Head very delicately striate longitudinally, densely reticulate between the striae. Thorax and node densely reticulate, pronotum and epinotum with traces of transverse rugae; postpetiole and gaster microscopically punctate.

Hair yellow, erect, rather sparse except on apex of gaster, short and suberect on legs. Pubescence white, very fine and adpressed, forming a thin silky covering on postpetiole and gaster, not hiding the sculpture.

Head as long as broad, occipital border short and straight, sides convex, angles broadly rounded. Mandibles as long as head, external border straight or very feebly concave, inner border convex, furnished with four large, sharp, erect teeth each preceded by two small denticles. Scapes not reaching the occipital border by fully their thickness; first and third segments of funiculus equal length, second one-fifth longer. Thorax two and one-third times longer than broad. Pronotum one and three-quarter times broader than long, convex in all directions; mesonotum as long as pronotum, circular, as long as broad, excision deep and wide; epinotum one-fourth longer than broad, convex transversely; in profile evenly convex from apex of pronotum to base of mesonotum with a very faint depression at promesonotal suture, mesonotum highest at middle; excision deep and wide; dorsum of epinotum feebly convex, twice as long as declivity into which it is rounded. Node very slightly longer than broad, slightly broader behind than in front, sides feebly convex, anterior border strongly convex, posterior border almost straight; in profile longer than high, anterior face short and vertical, rounded into the rather flattened dorsum, posterior face convex, very short, ventral spine short and broad, bluntly pointed. Postpetiole twice as broad as long, almost hemispherical; constriction deep and wide. First segment of gaster broader than long. Legs slender.

Male and female unknown.

Habitat.—South Australia: Ooldea (J. A. Kershaw).

Promyrmecia exigua sp. nov.

Plate XV, fig. 64

Worker. Length 4-4·5 mm.

Head and gaster blackish-brown, mandibles yellow; antennae, pronotum, mesonotum and legs brown or reddish-brown, tarsi of front and middle legs reddish-yellow; epinotum and node red.

Mandibles smooth and shining. Head finely and irregularly reticulate rugose, with some faint traces of longitudinal striae on the middle. Thorax and node more coarsely reticulate-rugose, rugae almost obsolete on mesonotum, somewhat arched on pronotum. Postpetiole and gaster microscopically reticulate.

Hair whitish-yellow, erect, long and abundant on body, shorter and suberect on legs. Pubescence grey, very fine and close lying, long and more abundant on postpetiole and gaster but not hiding sculpture.

Head as long as broad, sides and occipital border convex, angles very broadly rounded. Mandibles fully as long as head, external border concave at middle, inner border convex, furnished with six large, sharp, erect teeth, the first three large teeth each preceded by two small denticles. Scapes not extending to occipital border by fully their thickness, first and second segments of funiculus equal length, third one-seventh shorter. Thorax two and one-half times longer than broad; pronotum one-third broader than long, strongly convex in all directions, mesonotum circular, as long as broad, meso-epinotal excision deep, epinotum one-fourth longer than broad, feebly convex transversely; in profile pronotum weakly convex from apex to base; mesonotum higher than pronotum, highest at middle, strongly convex; excision deep; epinotum high and convex, highest behind, broadly rounded into declivity. Node as long as broad, pear-shaped, broadest behind; in profile as high as long, anterior and posterior faces short and vertical, both rounded into the convex dorsum, ventral spine short and sharp. Postpetiole as long as node, one and three-quarter times broader than long, sides and front strongly convex, constriction sharp and deep. First segment of gaster one-fourth broader than long, broader behind than in front. Legs long and slender.

Male and female unknown.

Habitat.—Victoria: Lake Hattah (J. E. Dixon).

The smallest species in the genus. In colour and sculpture this somewhat resembles *urens* Lowne, but the structure is quite different.

Promyrmecia dichospila Clark

Plate XV, figs. 53-55

Myrmecia (*Promyrmecia*) *dichospila* Clark, Proc. Roy. Soc. Vict., 50 (2), p. 359, fig. 2, 1938, ☿ ♀ ♂.

Worker. Length 7-9 mm.

Black, dorsum of node and a large spot on epinotum red. Mandibles yellow at base, reddish-yellow towards apex, teeth brown. Labrum reddish-yellow. Scapes brown, funiculi reddish-yellow. Tarsi and apex of tibiae brownish-yellow.

Mandibles finely striate-reticulate with a row of large deep punctures along the inner borders. Head finely striate-rugose longitudinally, densely and finely reticulate, not striate. Pronotum striate-rugose, transversely arched. Mesonotum striate-rugose longitudinally. Epinotum and node coarsely and irregularly rugose. Postpetiole and gaster very finely reticulate.

Hair yellowish, long and erect, particularly on clypeus and last three segments of gaster. None on antennae, very short and sparse on legs. Pubescence greyish, very fine and adpressed, long and abundant on gaster.

Head as long as broad, sides and occipital border straight, angles broadly rounded. Mandibles one-fifth shorter than head, external border concave, inner border strongly dentate, the third, fifth, seventh and ninth teeth twice as large as the others, the ninth forming a slight angle. Scapes not extending to occipital border by twice their thickness; first and second segments of funiculus equal in length, third one-fourth shorter. Thorax two and one-half times longer than broad. Pronotum one-third broader than long, strongly convex in all directions. Mesonotum circular, as long as broad. Epinotum slightly longer than broad, strongly convex transversely; in profile pronotum strongly convex from apex to

base. Mesonotum higher than pronotum, dropping behind, strongly convex. Epinotum feebly convex on dorsum, strongly rounded into declivity. Node slightly broader than long, fully twice as long as the stalk in front, convex in all directions; in profile slightly higher than long, apical third straight and vertical, sloping gradually to apex of stalk in front, dorsum convex, rounded into posterior face, ventral spine long and broad, sharp-pointed, directed forward. Postpetiole almost one-third broader than long, broadest at middle, strongly convex in all directions; constriction deep and wide. Gaster one and two-thirds times longer than broad. First segment of gaster one-fifth broader than long, much broader behind than in front, sides convex. Legs long and slender.

Female. Length 24·5-26 mm.

Colour, sculpture and pilosity similar to worker. Mandibles broader and straighter, teeth larger. Pronotum twice as broad as long, convex in all directions. Mesonotum short, one-fourth broader than long, sides and front semicircular, convex both ways on top, parapsidal furrows distinct. Wing stumps present. Scutellum circular, as long as broad, dome-shaped above. Epinotum feebly convex transversely. Node one-fifth broader than long. Postpetiole almost twice as broad as long. Legs slender.

Male. Length 9·5 mm.

Head and gaster black. Thorax, node, postpetiole and legs brownish-yellow, mandibles and scapes brown, funiculi yellowish-red.

Head finely punctate-reticulate, more coarsely punctate behind. Thorax and node finely and densely reticulate, with numerous large shallow punctures scattered throughout, coarser and more abundant on epinotum. Postpetiole and gaster finely and densely reticulate. Pilosity as in worker but the erect hairs longer.

Head almost one-third broader than long, strongly convex behind. Mandibles short, furnished with four strong sharp teeth. Clypeus broad, convex above, concave in middle in front. Frontal area large, triangular. Frontal carinae one-third longer than broad in front. Scapes two and one-half times longer than first segment of funiculus, second segment six times longer than first, remainder subequal to apical. Eyes large, occupying almost all the sides. Ocelli large. Thorax two and one-half times longer than broad. Pronotum short, strongly convex. Mesonotum one-fifth broader than long, convex in front, mayrian and parapsidal furrows and frontal groove in centre deeply impressed. Scutellum one-third broader than long, anterior edge feebly convex, sides and posterior edge strongly convex. Epinotum strongly convex transversely. Node circular, as long as broad, fully four times as long as the stalk in front, in profile like node of worker but ventral spine straight. Postpetiole as long as broad, almost three and one-half times broader behind than in front, sides straight to basal third then strongly convex. Gaster fully twice as long as broad. First segment almost one-third broader than long, much broader behind than in front. Genitalia retracted. Legs long and slender. Wings hyaline.

Habitat.—South Australia: Reevesby Island.

Promyrmecia pilosula Smith

Plate XIV, figs. 37-39

Myrmecia pilosula Smith, Cat. Hymen. Brit. Mus., vi, p. 146, 1858, ☿ ♀ ♂; Roger, Berl. Ent. Zeitschr., v, p. 35, 1861; Mayr, Verh. Zool. Bot. Ges. Wien, xii, p. 726, 1862.

Formica forficata Latreille, Fourmis, p. 216, pl. 8, fig. 50, 1802, ☿

Myrmecia (Myrmecia) pilosula Emery, Genera Insect., fasc. 118, p. 21, 1911.

Myrmecia (*Halmamyrmecia*) *pilosula* Wheeler, Biol. Bull., xlii, p. 195, 1922, ☿.

Myrmecia (*Promyrmecia*) *pilosula* Clark, Vict. Naturalist, xlii, p. 140, 1925; Wheeler, Colony-founding among Ants, p. 56, 1933, ☿.

Worker. Length 12-14 mm.

Black; mandibles, antennae, tibiae and tarsi yellow.

Apical half of mandibles with a large longitudinal groove and some coarse oblique striae. Head longitudinally striae, the striae very fine and widely spaced, densely and finely punctate between the striae. Pronotum longitudinally striate in the middle, circular at the sides, the striae larger and closer than on head. Mesonotum longitudinally striate, sometimes more striate-rugose, anterior fourth of epinotum longitudinally rugose, remainder, including declivity, transversely rugose. Node circularly rugose with a longitudinal central carinae. All interstices very finely and densely punctate-reticulate. Postpetiole and gaster microscopically punctate-reticulate.

Hair greyish, short, erect, moderately abundant throughout, longer and more abundant on gaster, very long and inclined on top and underside of mandibles, none on antennae, very short and suberect on legs. Pubescence white, very fine and short, adpressed, abundant throughout, longer and more abundant on postpetiole and gaster, forming a distinct covering but not hiding the sculpture.

Head one-sixth broader than long, feebly concave behind, sides convex, angles rounded. Mandibles not quite as long as head, external borders straight or feebly concave, inner border furnished with four large, sharp, erect teeth, the fourth forms a slight angle near base, from there the mandible is slightly reduced, between the large teeth is a smaller but sharp tooth. Scapes extend beyond occipital border by their thickness; first and third segments of funiculus equal in length, one-tenth shorter than second, apical almost twice as long as the preceding. Thorax barely twice as long as broad. Pronotum twice as broad as long, sides and front convex, dorsum flattened or feebly concave. Mesonotum one-sixth broader than long, strongly convex in all directions. Epinotum one-eighth longer than broad; dorsum flattened; in profile pronotum convex from apex to base. Mesonotum higher than pronotum and epinotum, highest in front, flatly convex, dropping behind; meso-epinotal suture deep and narrow. Epinotum strongly convex from base to foot of declivity. Node one-fifth broader than long, convex in all directions; in profile one-fifth higher than long, almost dome-shaped above, all faces convex, ventral spine long and stout, bluntly pointed. Postpetiole barely twice as broad as long, strongly convex in all directions; constriction wide and deep. First segment of gaster one-sixth broader than long. Legs long and slender.

Female. Length 14-16 mm.

Colour and pilosity as on the worker. Sculpture coarser, more irregular. Node one and three-fourth times broader than long, sides convex, anterior and posterior faces straight or feebly convex.

Male. 11-12 mm.

Colour as on the worker.

Mandibles shining, superficially punctate. Head behind the eyes coarsely punctate, the punctures large and shallow, front of head and bottoms of punctures very finely and densely punctate. Thorax and node irregularly punctate, the punctures large and shallow, obsolete in places, the whole, including postpetiole and gaster, very finely and densely punctate.

Hair grey, very long and abundant throughout, shorter on legs. Pubescence white, slightly yellowish on gaster, very fine and abundant.

Head one-fifth broader than long, greatly reduced behind. Mandibles triangular,

with one large tooth at centre between apex and base of inner border. Scapes twice as long as first segment of funiculus, second segment of funiculus five times as long as first, third segment four and one-half times longer than first. Thorax twice as long as broad. Pronotum four times broader than long. Mesonotum with sharply defined mayrian and parapsidal furrows. Scutellum as long as broad, broadest in front. Node slightly broader than long, convex in all directions; in profile higher than long, dome-shaped, higher in front, stalk half as long as node, ventral spine long, slender and sharp. Postpetiole one-third broader than long, broadest at posterior third, constriction deep and wide; first segment of gaster one-eighth broader than long. Legs long and slender. Wings hyaline.

Habitat.—Tasmania: Hobart (type locality).
New South Wales: Whole State.
Western Australia: Albany; Mundaring (J. Clark).
South Australia: Mt. Lofty (A. H. Elston); Kangaroo Island (D. J. Mahony); Normanville (H. Womersley).
Queensland: Fletcher and Stanthorpe (E. E. Sutton).

Very abundant in all the eastern States. Commonly known as the "black jumper," this is the most common and widely distributed species in the genus. In Western Australia it is quite common in Albany and surrounding district, but is rare farther north. In Queensland it ranges north to Rockhampton.

Promyrmecia michaelseni Forel

Plate XIII, figs. 17-18

Myrmecia michaelseni Forel, Fauna Sudwest. Austrl., i, p. 267, 1907, ☿.
Myrmecia (*Myrmecia*) *michaelseni* Emery, Gen. Insect., fasc. 118, p. 21, 1911, ☿.
Myrmecia michaelseni var. *perthensis* Crawley, Ann. Mag. Nat. Hist. (9), ix, p. 431, 1922, ☿.
Myrmecia (*Promyrmecia*) *michaelseni* Wheeler, Colony-founding among Ants, p. 59, 1933.

Worker. Length 10-12 mm.

Black; mandibles, antennae and legs brown, tarsi reddish.

Mandibles smooth, some obsolete striae near tips. Head finely striate longitudinally, very finely and densely punctate between the striae. Pronotum and mesonotum finely striate longitudinally. Epinotum more coarsely striate, longitudinal in front, irregular behind and transverse on the declivity. Node irregularly rugose with a longitudinal direction. Postpetiole and gaster densely and microscopically punctate.

Hair whitish or yellow, moderately long, abundant and erect throughout, much longer on clypeus and apical segments of gaster, hardly apparent on antennae except at apex of scapes. Pubescence white, very fine and adpressed on head, thorax, antennae and legs, longer and more abundant on postpetiole and sides of gaster, top of gaster covered with long golden-red pubescence which hides the sculpture.

Head slightly broader than long, occipital border straight or feebly concave, angles rounded. Mandibles very slightly longer than head. Frontal carinae swerving behind, as long as broad. Scapes just reach to the posterior border of head; first segment of funiculus as long as second, remainder subequal to apical, this is as long as the first but shorter than the two preceding combined. Thorax twice as

long as broad. Pronotum twice as broad as long, sides and front strongly convex, depressed above. Mesonotum one-third broader than long, sides and front strongly convex, weakly convex behind. Meso-epinotal depression deep. Epinotum one-third longer than broad, convex in all directions; in profile pronotum and mesonotum united in a long convexity, slightly flattened at pro-mesonotal suture. Meso-epinotal suture deep and wide, epinotum strongly arched into declivity. Node as broad as long, much broader behind than in front, sides and posterior border convex, anterior border short and straight; in profile as high as long, anterior and posterior faces straight, vertical, dorsum concave, angles bluntly pointed, ventral spine long, broad and sharp. Postpetiole one-third broader than long, strongly convex in front. First segment of gaster one-sixth broader than long, strongly convex. Legs slender.

Female. Length 13·5-15 mm.

Colour, sculpture and pilosity as in the worker. Larger and more robust. Mandibles similar but larger and broader. Node one-fourth broader than long. Postpetiole one-third broader than long. Wings with a slight brownish tinge.

Male. Unknown.

Habitat.—Western Australia: Albany; Denmark; Nornalup; Bridgetown; Armadale; Perth; Mundaring.

The worker is described from a co-type received from the late Dr. Michaelsen. The female from a nest found at Albany. This species is abundant in the Albany district and is found sparingly from Albany to Perth. The measurements given by Forel for the nodes of this species do not apply to the co-types received nor to the majority of large numbers of nests found in various districts. The variety described by Crawley from Perth is the typical form.

Promyrmecia michaelseni Forel s.sp. *queenslandica* Forel

Plate XIII, fig. 19

Myrmecia michaelseni Forel r. *queenslandica* Forel, Arkiv. f. Zool., 9, 16, p. 4, 1915, ☿.

Myrmecia michaelseni s.sp. *overbecki* Veihmeyer, Ent. Mitteil., xiii, p. 222, 1924, ☿ ♀.

Worker. Length 11-13 mm.

Colour as in *P. michaelseni* Forel. Sculpture coarser, more rugose. Hair longer and more abundant. Pubescence on gaster not so bright red, more yellowish-red.

Mandibles as long as head. Scapes not extending to the occipital border by fully their thickness; segments of funiculus thicker. In general more robust than *michaelseni*.

Female. Length 15·5 mm. (after Viehmeyer).

Mandibles somewhat shorter, not longer than the head, but broader, the fine ridge at base of teeth much more distinct than in the worker. Petiole distinctly broader than long, its posterior face in profile concave. Wings missing.

Male. Unknown.

Habitat.—Queensland: Lamington Plateau (type locality, E. Mjöberg); Fletcher; Stanthorpe (E. Sutton).

New South Wales: Lismore (C. F. Deuquet); Grafton (J. Clark); Trial Bay (H. Overbeck).

Promyrmecia ruginodis n.sp

Plate XIII, figs. 20-22

Worker. Length 12-14 mm.

Black; mandibles, antennae and legs reddish-brown.

Mandibles finely punctate-reticulate, three or four fine striae near apex and a row of large deep punctures along the inner edge at base of teeth. Head finely and longitudinally striate-rugose, large shallow punctures between the rugae, the whole surface very finely and densely punctate. Pronotum and mesonotum finely striate longitudinally, shining between the striae. Epinotum longitudinally striate in front, transversely striate behind. Top of node longitudinally striae-rugose. Postpetiole striate longitudinally, densely punctate between the striae. Gaster very finely and densely punctate.

Hair yellow, long and erect, rather sparse on head and thorax, longer and abundant on nodes and gaster. Short and suberect on legs. None on antennae except a few at apex of scapes. Pubescence yellow, very fine and adpressed, longer and abundant on postpetiole and gaster, particularly on middle of first segment, where it hides the sculpture.

Head one-eighth broader than long, sides and occipital border feebly convex, angles broadly rounded. Mandibles as long as head, external border feebly concave, inner border furnished with six large sharp teeth and a smaller tooth between each. Frontal carinae as long as broad behind. Scapes extend to posterior border; first segment of funiculus slightly shorter than second, apical as long as second, remainder sub-equal. Thorax barely twice as long as broad. Pronotum twice as broad as long, convex in all directions. Mesonotum one-third broader than long, oval. Epinotum twice as long as broad; in profile pronotum and mesonotum combined evenly convex from base to apex; constriction between mesonotum and epinotum deep. Epinotum evenly convex from base to foot of declivity. Node one-third broader than long, broadest behind, convex in all directions; in profile anterior face straight above, sloping forward from the middle below, posterior face feebly concave, or straight, dorsum convex, angles rounded, the ventral spine short and sharp. Postpetiole one-third broader than long, sides strongly convex. First segment of gaster one-eighth broader than long. Legs robust.

Female. Length 15 mm.

Colour and pilosity as in the worker, sculpture coarser particularly on the mandibles, head and node.

Mandibles broader, external border straight, teeth longer. Head square behind. Node one-fourth broader than long, oval. Postpetiole almost twice as broad as long. In all other respects similar to the worker.

Male. Length 11·5 mm.

Black; mandibles, antennae and legs brown, tarsi lighter. Wings hyaline, nervures yellow.

Mandibles finely striate on outer border, smooth and shining in middle and inner border. Head finely rugose, very finely and densely punctate between the rugae. Pronotum, scutellum, mesonotum and node irregularly punctate-rugose, very densely punctate between rugae. Epinotum transversely rugose. Postpetiole finely but sharply rugose, very finely and densely punctate, the gaster similarly finely punctate.

Hair whitish, abundant, long and erect throughout, short and suberect on legs, none on antennae. Pubescence white, very fine and adpressed, most abundant on postpetiole and gaster, yellowish and longer on middle of gaster but not hiding the sculpture.

Head one-sixth broader than long, strongly convex behind eyes. Mandibles

short and triangular, furnished with three strong sharp teeth. Frontal carinae short and depressed. Insertions of antennal scapes exposed. Scapes one-fourth longer than broad, almost twice as long as first segment of funiculus, second segment five times longer than first. Thorax barely twice as long as broad. Pronotum five times broader than long, strongly convex. Mesonotum one-fourth broader than long, mayrian furrows sharply but not deeply impressed, parapsidal furrows sharply impressed. Scutellum one-third broader than long; in profile pronotum erect, convex. Mesonotum raised, convex, mayrian furrow deeply impressed. Scutellum dome-shaped, longer than high. Epinotum convex from base to foot of declivity. Node one-sixth broader than long, almost circular; in profile the anterior face sloping gradually backward, posterior face short and straight, dorsum convex, both edges rounded; the ventral spine short and sharp. Pronotum almost twice as broad as long, sides strongly convex. First segment of gaster one-fifth broader than long. Legs long and slender.

Habitat.—Western Australia: Perth; Armadale; Ludlow (J. Clark).

In size and colour this species resembles *P. michaelseni* Forel. The sculpture is quite different.

Promyrmecia chrysogaster n.sp.

Plate XIII, fig. 23

Worker. Length 9 mm.

Black; mandibles, antennae and anterior coxae brown; legs, including middle and hind coxae, yellow.

Mandibles with coarse obsolete striae in the middle of dorsum, finely reticulate on basal third. Head finely striate longitudinally. Thorax and node longitudinally striate, more coarsely than on head, epinotal declivity transversely striate. Postpetiole and gaster microscopically punctate.

Hair yellow, fine, long, erect and abundant throughout, shorter on legs, none on antennae except at apex of scapes. Pubescence white, very fine and adpressed throughout, long and very abundant on postpetiole, yellow on gaster, long and adpressed, forming a golden covering hiding the sculpture.

Head as long as broad, sides and occipital border straight, angles broadly rounded. Mandibles as long as head, external border strongly concave in middle, inner edge furnished with six large, sharp, erect teeth with a small tooth between each. Frontal carinae as long as broad behind. Scapes not extending to occipital border by fully their thickness. Second segment of funiculus one-fifth longer than first. Thorax twice as long as broad. Pronotum twice as broad as long, sides and front convex. Mesonotum one-third broader than long, oval. Epinotum one-fifth longer than broad; in profile convex in front, dorsum of pronotum, mesonotum and epinotum straight with a deep and wide incision at meso-epinotal suture, declivity of epinotum shorter than dorsum into which it is rounded. Node as long as broad, convex in all directions; in profile slightly higher than long, anterior face sloping backward, convex, rounded into the convex dorsum, posterior face slightly concave, the top edge rounded, the ventral spine short and blunt. Postpetiole one-third broader than long, sides and front strongly convex. First segment of gaster broader than long, sides convex. Legs slender.

Male and female unknown.

Habitat.—Queensland: Brisbane (C. Barrett).

The general colour gives this species the appearance of *P. fulvipes* Roger; it is, however, more closely related to *P. michaelseni* Forel.

Promyrmecia cydista sp. nov.

Plate XIII, fig. 24

Worker. Length 9-12 mm.

Black; basal half of mandibles yellow, apical half yellowish-brown, antennae and legs brown, tarsi reddish-brown.

Basal half of mandible smooth, microscopically reticulate, apical half with four or five large, shallow, elongate punctures. Head very finely striate longitudinally, interstices wide, densely and finely reticulate and with scattered shallow punctures. Pronotum and mesonotum longitudinally striate-rugose, coarser than on head; epinotum and node coarsely and irregularly punctate-rugose, all interstices finely and densely reticulate. Postpetiole and gaster microscopically reticulate.

Hair yellow, short and erect, abundant throughout, longer on apical segments of gaster; sparse, short and suberect on legs, a few at apex of scapes. Pubescence whitish, very fine and adpressed throughout; yellow, longer and more abundant on postpetiole but not hiding sculpture, long and forming a dense covering on gaster.

Head very slightly broader than long, sides feebly convex, occipital border feebly concave, angles broadly rounded. Mandibles shorter than head, external border feebly concave, inner border furnished with five large, sharp, erect teeth, with two smaller teeth preceding each large tooth. Scapes not extending to occipital border by their thickness; first and third segments of funiculus equal in length, second very slightly longer. Thorax twice as long as broad; pronotum almost twice as broad as long, sides and front strongly convex, dorsum flattened; mesonotum one-fifth longer than pronotum and one-sixth broader than long; constriction deep and wide; epinotum as long as broad, feebly convex transversely; in profile pronotum evenly convex from apex to base; mesonotum much higher than pronotum and epinotum, highest in front, meso-epinotal excision deep, epinotum evenly convex from base to foot of declivity. Node one-fourth broader than long, broadest behind, anterior and posterior borders straight or feebly convex, sides strongly convex; in profile dome-shaped, higher than long, ventral spine thorn-like, sharp. Postpetiole one-third broader than long, broadest behind middle; constriction deep and wide. First segment of gaster one-fifth broader than long. Legs slender.

Male and female unknown.

Habitat.—New South Wales: Lismore (C. F. Denquet); Dorrigo (W. Heron); Sydney (W. W. Froggatt); Wahroonga (H. J. Carter).

Resembles *P. michaelseni* in colour but is much smaller, more slender and differently sculptured. The yellow mandibles, shape of thorax and nodes distinguish them.

Promyrmecia chasei Forel

Plate XIII, figs. 25-27

Myrmecia chasei Forel, Ann. Soc. Ent. Belg., xxxviii, p. 235, 1894, ☿.

Myrmecia (*Myrmecia*) *chasei* Emery, Genera Insect., fasc. 118, p. 21, 1911, ☿.

Myrmecia pilosula Smith s.sp. *mediorubra* Forel, Rev. Suisse Zool., xviii, p. 7, 1910, ☿.

Myrmecia (*Myrmecia*) *pilosula* Smith s.sp. *mediorubra* Emery, Genera Insect., fasc. 118, p. 21, 1911, ☿.

Myrmecia (*Myrmecia*) *chasei* Crawley, Ann. Mag. Nat. Hist. (9), ix, p. 431, 1922, ☿.

Myrmecia (*Promyrmecia*) *mediorubra* Wheeler, Colony-founding among Ants, p. 58, 1933, ☿.

Worker. Length 12-15·5 mm.

Head, postpetiole and gaster black, antennae and legs brown, mandibles, apical segments of funiculus and tarsi yellow, thorax and node light red.

Front half of mandibles striate, base smooth, finely punctate. Head finely striate longitudinally, the striae widely spaced; very finely and densely punctate between the striae. Pronotum, mesonotum and front of epinotum sculptured as on the head but the striae large, epinotal declivity transversely striate, node circularly striate with a strong central longitudinal carina. Postpetiole and gaster densely and microscopically punctate.

Hair whitish, short and erect, abundant throughout. Pubescence white, very fine and adpressed on head and thorax, long and more abundant on postpetiole and gaster, on the middle of first segment it is yellowish and dense, almost hiding the sculpture.

Head very slightly broader than long, straight or feebly concave behind, the angles broadly rounded into sides. Mandibles a fraction longer than head, external border straight, inner border furnished with five large erect teeth, with a smaller tooth between each. Frontal carinae erect, longer than broad behind. Scapes extend to occipital border; second segment of funiculus one-third longer than first. Thorax twice as long as broad. Pronotum fully twice as broad as long, strongly convex all ways. Mesonotum almost one-fourth broader than long. Epinotum one and one-half times longer than broad; in profile pronotum convex from base to apex. Mesonotum convex, raised above level of pronotum and epinotum, meso-epinotal suture narrow and deep, epinotum convex from base to foot of declivity. Node one and one-half times broader than long, oval; in profile higher than long, anterior face short and vertical, posterior edge sharply rounded. Ventral spine short and sharp. Postpetiole twice as broad as long, sides and front strongly convex. First segment of gaster one-sixth broader than long. Legs short and stout.

Female. Length 22-24 mm.

Colour as in the worker, but there is a brown spot on each side of the dorsum of scutellum and one on each side of dorsum of node. Wings hyaline. Sculpture and pilosity similar, but the pubescence darker and more abundant on gaster.

Head one-fifth broader than long, occipital border straight or feebly concave, sides feebly convex, angles broadly rounded. Mandibles as long as head, external border convex, inner border convex, furnished with five large, sharp, erect teeth with a smaller tooth between each. Scapes not extending to occipital border by fully twice their thickness; second segment of funiculus very slightly longer than first. Mayrian furrows indicated but not impressed. Node twice as broad as long, broader behind than in front, sides strongly convex, posterior border feebly convex, anterior border concave in middle. Postpetiole twice as broad as long, almost oval. First segment of gaster broader than long. Legs short and robust.

Male. Length 14·5 mm.

Black; a large spot on each side of pronotum, the whole of the mesonotum, epinotum and node yellowish-red, mandibles and legs blackish-brown, antennae and tarsi reddish-brown.

Head, thorax and node coarsely punctate-reticulate, postpetiole and gaster very densely and finely punctate.

Hair yellowish-white, erect, long and abundant throughout, pubescence white,

very fine and adpressed, very abundant on postpetiole and gaster but not hiding the sculpture, darker on middle of first segment.

Head very slightly broader than long, strongly convex behind the eyes. Mandibles furnished with three strong sharp teeth. Frontal carinae as long as broad behind. Scapes one-third longer than broad, and twice as long as first segment of funiculus, second segment of funiculus six times longer than first. Thorax twice as long as broad. Pronotum five times broader than long, sides and front convex. Mesonotum slightly broader than long, convex in all directions, mayrian and parapsidal furrows deeply impressed. Scutellum one-third broader than long, broadest in front. Epinotum almost twice as broad as long, convex laterally; in profile pronotum erect, convex. Mesonotum high and convex mayrian furrows deeply impressed. Scutellum dome-shaped, longer than high. Epinotum short, strongly convex from base to foot of declivity. Node one-third broader than long, oval; in profile longer than high, anterior face straight, sloping gradually backward, posterior face short, convex, rounded into convex dorsum, anterior edge bluntly rounded. Postpetiole barely twice as broad as long, sides strongly convex. First segment almost one-fourth broader than long. Legs slender.

Habitat.—Western Australia: Perth; Mundaring; Armadale; Bridgetown; Albany; Denmark (J. Clark).

The workers vary greatly in size in some nests. The queen is huge in bulk in comparison with even the largest workers. As a rule in most of the known species there is very little difference in the size of the workers and queens. A female from Garden Island has the head brown, straighter behind and the whole sculpture coarser.

Promyrmecia chasei Forel var. *ludlowi* Crawley

Myrmecia chasei Forel, var. *ludlowi* Crawley, Ann. Mag. Nat. Hist. (9), ix, p. 431, 1922, ☿ ; Crawley, l.c., xvi, p. 578, 1925, ♂.

Worker. Length 12-15 mm.

Agrees with *P. chasei* Forel in all details except colour. The mandibles, antennae and legs brown, tarsi reddish. Head, postpetiole and gaster black, the thorax, instead of being entirely red, is black on the neck of the pronotum, a large spot on centre of mesonotum, lower half of the mesosternum and metasternum.

Female. Length 22 mm.

Colour darker than *P. chasei*, otherwise similar. One fully-developed female form Ludlow has no traces of wings.

Male. Length 14 mm.

Similar to the male of *P. chasei* Forel.

Habitat.—Western Australia: Ludlow; Armadale (J. Clark).

This colour variation is constant; no graduation between the two forms has been found.

The male described from Albany by Crawley is the male of *chasei*, which is common there; the var. *ludlowi* is not found in that locality.

Promyrmecia harderi Forel

Plate XIII, figs. 28, 29

Myrmecia harderi Forel, Rev. Suisse Zool., xviii, p. 8, 1910, ☿.
Myrmecia (*Myrmecia*) *harderi* Emery, Gen. Insect., fasc. 118, p. 21, 1911, ☿.

Worker. Length 10·5 mm.

Head and gaster black, mandibles yellow, antennae and tarsi reddish-yelow. Legs, coxae and base of mesosternum brown, thorax, node and centre of postpetiole yellowish-red.

Mandibles smooth and shining on basal half, coarsely striate on apical half. Head very finely striate longitudinally, finely reticulate between the striae. Mesonotum feebly and irregularly rugose, the rugae almost longitudinal, densely reticulate. Epinotum and node much more coarsely and irregularly rugose. Postpetiole longitudinally striate-rugose. Gaster microscopically punctate.

Hair yellow, short and erect on head, thorax and legs, longer and more abundant on node, postpetiole and gaster. Pubescence white, very fine and adpressed, much longer and more abundant on gaster but not hiding the sculpture.

Head very slightly broader than long, occipital border feebly concave, sides convex. Mandibles as long as head, slender, parallel, external border concave, inner border furnished with five large, short, erect teeth, with a smaller tooth between each. Scapes just reach the occipital border; second segment of funiculus barely one-fourth longer than first. Thorax fully twice as long as broad. Pronotum twice as broad as long, sides and front strongly convex, dorsum flattened. Mesonotum very slightly broader than long, almost circular. Epinotum one-third longer than broad; in profile pronotum and mesonotum united in an even convexity with a feeble impression at suture, meso-epinotal suture deep but not wide. Epinotum convex from base to foot of declivity. Node as long as broad, circular, convex on top; in profile longer than high, anterior face short, rounded into dorsum, posterior face and dorsum united convex, ventral spine very short, sharp. Postpetiole one-fourth broader than long, convex from base to apex. First segment of gaster very slightly broader than long. Legs stout.

Female. Length 14·5 mm.

Differs from the worker in being larger, more robust and winged. Mayrian furrows feebly impressed on mesonotum. The mandibles slightly shorter and broader, the scapes do not reach the occipital border.

Habitat.—New South Wales: Gunnedah; Narrabri; Dubbo (W. W. Froggatt).

The worker is re-described from a co-type received many years ago from the late W. W. Froggatt.

Promyrmecia scabra sp. nov.

Plate XIV, figs. 40-41

Worker. Length 11-11·5 mm.

Black; half of pronotum, whole of epinotum and node red. Mandibles yellow on basal half, apical half darker, antennae and tibiae brown, tarsi more reddish.

Basal half of mandibles very finely and densely reticulate, with some large, shallow punctures, apical half longitudinally striate. Head finely striate longitudinally, the striae widely separated, interstices densely reticulate. Pronotum and mesonotum longitudinally striate-rugose. Epinotum and node more coarsely and irregularly rugose, all interstices densely reticulate. Postpetiole more finely rugose,

the rugae with a longitudinal direction and more or less obsolete, some obsolete punctures showing, the interstices densely and finely punctate, gaster very finely and densely reticulate.

Hair yellowish, erect, short on head and thorax, longer on nodes and gaster, very short and suberect on legs, none on antennae. Pubescence yellowish, very fine and adpressed, forming a distinct covering on gaster but not hiding sculpture.

Head very slightly broader than long, sides convex, occipital feebly concave in middle, angles rounded. Mandibles as long as head, external border feebly concave, inner border convex, furnished with four large, sharp, erect teeth, each preceded by two small teeth. Scapes just reach occipital border, first and third segments of funiculus equal length, one-fifth shorter than second. Thorax twice as long as broad. Pronotum twice as broad as long. Mesonotum slightly broader than long, almost circular, excision deep and wide. Epinotum one-fifth longer than broad, convex transversely; in profile pronotum evenly convex from apex to base; mesonotum higher than pronotum and epinotum, highest in front of middle, dropping behind; epinotum convex from base to bottom of declivity. Node slightly broader than long, broadest behind middle, convex in all directions; in profile slightly higher than long, anterior face high, basal half straight, upper half convex, posterior face short, convex, continuous with dorsum into anterior face; ventral spine short and sharp. Postpetiole three-fifths broader than long, sides and front strongly convex, broadest behind middle. First segment of gaster one-sixth broader than long, broadest at middle. Legs long and robust.

Female. Length 15·5 mm.

Colour, sculpture and pilosity as on the worker. Larger and more robust. Head one-eighth broader than long, mandibles not reaching occipital border by fully their width at base. Scapes not reaching occipital border by fully their width at apex. Node one-fourth broader than long, oval. Postpetiole five-eighths broader than long. Legs robust. Wings hyaline.

Male. Unknown.

Habitat.—South Australia: Leigh's Creek.

In general appearance similar to *P. harderi* Forel, but distinguished by the form of the mandibles, thorax and nodes.

Promyrmecia occidentalis sp. nov.

Plate XIII, figs. 30, 31

Worker. Length 11-12 mm.

Head, pronotum, mesonotum and gaster black; mandibles yellow, antennae and legs reddish-yellow; epinotum, node and postpetiole light red.

Head finely striate-rugose, interstices densely reticulate. Pronotum more coarsely striate-rugose, longitudinally arched. Mesonotum and epinotum longitudinally striate-rugose, declivity of epinotum transversely striate. Node irregularly rugose. Postpetiole and gaster microscopically reticulate.

Hair yellow, short and erect, sparse throughout, but more abundant and longer on gaster. Pubescence white, apparent on postpetiole and gaster, very fine and adpressed.

Head very slightly broader than long, occipital border straight or feebly concave, sides convex, angles rounded. Mandibles as long as head, external border concave, inner border convex, furnished with five large, sharp, erect teeth, with two small teeth between each. Scapes extend beyond occipital border by their thickness; second segment of funiculus one-fourth longer than first. Thorax two and one-

third times longer than broad. Pronotum twice as broad as long, strongly convex on front and sides. Mesonotum slightly broader than long, convex in all directions. Epinotum one-third longer than broad, flattened laterally; in profile evenly convex to base, suture sharply impressed. Mesonotum convex, highest at middle, suture deep and wide. Epinotum evenly convex from base to apex. Node circular, as long as broad; in profile as high as long, anterior and posterior faces vertical, straight, dorsum convex, edges rounded. Ventral spine short and sharp. Postpetiole one-third broader than long, sides convex. First segment of gaster one-seventh broader than long, sides evenly convex. Legs long and slender.

Female. Length 13 mm.

Head, pronotum, scutellum, mesonotum and gaster black, mandibles and labrum yellow, basal half of scapes brown, apical half and all the funiculus and legs reddish-yellow, epinotum, node and postpetiole red.

Sculpture similar to that of worker but coarser, the dorsum of epinotum irregularly, not longitudinally, rugose.

Pilosity similar but longer and more abundant.

Head one-tenth broader than long, sides feebly convex, occipital border concave, angles rounded. Mandibles barely as long as head, straighter and more strongly toothed than in worker. Scapes barely reach occipital border. Node one-fourth broader than long.

Male. Unknown.

Habitat.—Western Australia: Tammin; Eradu (J. Clark); Merridin (L. J. Newman); Beverley (E. du Boulay).

Resembles *P. chasei*, but distinguished by the more slender and smaller size, as well as the yellow antennae and legs.

Promyrmecia celaena sp. nov

Plate XIV, fig. 42

Worker. Length 10-11 mm.

Black; mandibles yellow, antennae and legs brown, tarsi reddish-brown.

Mandibles coarsely striate-rugose on apical two-thirds, very finely striate on basal third. Head finely striate longitudinally, interstices wide and densely punctate-reticulate. Pronotum and mesonotum longitudinally striate-rugose, transversely arched on front of pronotum, epinotum irregularly punctate-rugose, the punctures large and shallow, node more coarsely rugose; postpetiole irregularly striate-rugose, the rugae with a more or less longitudinal direction, interstices densely reticulate, gaster microscopically punctate-reticulate.

Hair yellow, fine, short and erect on head and thorax, longer on node and gaster, short and sub-erect on legs. Pubescence white, very fine and adpressed, abundant throughout, long and more dense on postpetiole, longer and coarser on gaster, forming a faint yellowish covering but not hiding sculpture.

Head slightly broader than long, sides convex, occipital border concave, angles broadly rounded. Mandibles not as long as head, fully their width at base shorter, external border concave, inner border convex, furnished with four large, sharp, erect teeth, each preceded by two smaller teeth. Scapes not extending to occipital border by fully their thickness; first and second segments of funiculus equal in length, third very slightly shorter. Thorax twice as long as broad. Pronotum twice as broad as long, convex in all directions. Mesonotum one-sixth broader than long, one-fifth longer than pronotum, excision deep and wide; epinotum as long as broad, convex laterally; in profile pronotum convex from apex to base,

mesonotum higher than pronotum, highest at middle, evenly convex, dropping behind; excision deep and wide; epinotum evenly convex from base to foot of declivity. Node barely one-fifth broader than long, broadest at middle, convex in all directions; in profile higher than long, dome-shaped, anterior and posterior faces vertical and short, rounded into convex dorsum, ventral spine long, slender and sharp. Postpetiole one-third broader than long, broadest at basal fourth, constriction deep and wide. First segment of gaster one-tenth broader than long, broadest at middle, sides evenly convex. Legs long and robust.

Male and female unknown.

Habitat.—New South Wales: Pilliga (W. W. Froggatt); Narrabri (W. W. Froggatt).

Queensland: Millmerran (J. Macqueen).

In size and colour this species is similar to *P. clarki* from Western Australia. The formation of the mandibles and nodes readily separates them.

Promyrmecia maloni sp. nov

Plate XIV, fig. 43

Worker. Length 10-11 mm.

Black; dorsum and sides of pronotum, epinotum and node red, edged with black below. Mandibles yellow, funiculus and tibiae brown, tarsi yellowish-brown.

Basal half of mandibles smooth, apical half coarsely striate-rugose. Head with fine, longitudinal, widely spaced striae, clypeus and spaces between the striae finely and densely punctate-reticulate. Pronotum and mesonotum longitudinally striate-rugose, coarser and more widely spaced than on head. Epinotum and node coarsely but shallowly punctate-rugose, the declivity of epinotum transversely rugose, densely and finely reticulate-punctate between the rugae. Postpetiole superficially punctate-rugose, the punctures large and very shallow, finely and very densely reticulate-punctate throughout. Gaster and legs microscopically reticulate.

Hair yellow, short and erect, abundant on head, thorax and legs, none on antennae, long and more abundant on gaster. Pubescence white, very fine and adpressed, most abundant on gaster and legs, on most examples the pubescence on dorsum of gaster is longer and yellowish, forming a slight covering but not hiding the sculpture.

Head one-seventh broader than long, sides convex, occipital border concave, angles rounded. Mandibles not as long as head, external border feebly convex, inner border furnished with four large teeth and small teeth between the larger. Frontal carinae almost one-fourth longer than broad. Scapes just reach occipital border; first and third segments of funiculus equal in length, one-tenth shorter than second, apical one-third longer than preceding. Thorax two and one-sixth times longer than broad. Pronotum twice as broad as long, convex in all directions. Mesonotum as long as broad, circular. Epinotum one-fourth longer than broad, broadly rounded in front; in profile pronotum raised, evenly convex. Mesonotum highest in front, slightly higher than pronotum, convex and dropping behind, constriction between mesonotum and epinotum deep. Dorsum and declivity of epinotum united in a broad arch. Node slightly broader than long, almost circular; in profile slightly higher than long, anterior face straight and vertical, dorsum and posterior face convex, ventral spine short, broad and sharp. Postpetiole barely twice as broad as long, strongly convex in all directions, constriction sharply impressed, narrow. First segment of gaster broader than long, broadest behind, strongly convex. Legs long and robust.

Female and male unknown.

Habitat.—Victoria: Inglewood (Sep., 1939).

In general appearance like *P. occidentalis*, but much more slender. The colour varies slightly; one example has only the dorsum of the epinotum and the node red.

This species is dedicated to Mr. M. J. C. Malone, of the Museum staff, in recognition of his assistance in typing the work.

Promyrmecia elegans sp. nov.

Plate XIV, figs. 44-45

Worker. Length 13-14·5 mm.

Head, postpetiole, gaster and all coxae black, postpetiole with a large reddish patch at each side, mandibles and antennae yellow, legs reddish-yellow. Thorax and node bright red.

Basal half of mandibles densely punctate, apical half coarsely and obliquely striate. Head, pronotum and mesonotum longitudinally striate, very finely and densely reticulate between the striae. Basal third of epinotum coarsely and irregularly rugose, transversely rugose behind. Node circularly rugose. Postpetiole and gaster finely and densely reticulate. Scapes and legs finely and densely reticulate.

Hair yellow, short and erect, sparse on head and thorax, more abundant on postpetiole and gaster, very long on node and apex of gaster, short and suberect on legs, none on antennae. Pubescence whitish, very fine and adpressed, apparent only on postpetiole and gaster.

Head as broad as long, occipital border straight or very feebly concave, sides feebly convex, posterior angles broadly rounded. Mandibles slightly longer than head, external border concave in middle, inner border furnished with ten sharp teeth, the first two very small. Frontal carinae as long as broad at middle. Scapes extend beyond the occipital border by about half their thickness. Second segment of funiculus twice as long as first, remainder subequal, apical-pointed, one-third longer than the preceding. Thorax two and one-fourth times longer than broad. Pronotum almost twice as broad as long, strongly convex in all directions. Promesonotal suture sharply impressed. Mesonotum one-sixth broader than long, convex in all directions, meso-epinotal suture deep and wide. Epinotum one-third longer than broad, convex laterally; in profile pronotum raised and strongly convex in front, flatly convex behind. Mesonotum rather flatly convex. Epinotum strongly and evenly convex from base to foot of declivity. Meso-epinotal suture deep and wide. Node one-fifth broader than long, all faces convex; in profile higher than long, top half of anterior face short and vertical, bottom half sloping forward and downward at an acute angle, posterior face short and vertical, rounded into the dorsum, anterior edge of dorsum bluntly rounded. Ventral spine very short and sharp. Postpetiole barely twice as broad as long, broadest and strongly convex at basal third, constriction deep and narrow. First segment of gaster broader than long, strongly convex. Legs long and slender.

Female. Length 16 mm. (deälated).

Colour, sculpture and pilosity as in the worker.

Larger and more robust. Head very slightly broader than long. Mandibles stronger, not as long as head. Scapes not extending to occipital border by fully their thickness. Thorax robust; parapsidal furrows sharply impressed, mayrian

furrows feebly indicated. Node fully one-third broader than long, anterior edge feebly concave in middle. Postpetiole almost twice as broad as long. Legs stout.

Habitat.—Western Australia: Hovea; Mt. Dale; Mundaring (J. Clark).

Promyrmecia opaca sp. nov.

Plate XIV, figs. 46-47

Worker. Length 11-11·5 mm.

Head, thorax and gaster black; dorsum of epinotum, node and in parts the postpetiole blood-red; mandibles yellow, antennae and legs reddish-brown.

Mandibles coarsely punctate-rugose in front, finely reticulate on basal half. Head finely and densely striate-rugose longitudinally, very finely and densely reticulate between striae. Pronotum, mesonotum and anterior fourth of epinotum longitudinally striate-rugose, coarser than on head, epinotum transversely rugose. Node irregularly, almost circularly rugose. Postpetiole and gaster very finely and densely reticulate.

Hair yellow, short and erect throughout, longer and more abundant on apical segment of gaster, very short and suberect on antennae and legs. Pubescence white, very fine and adpressed, abundant on postpetiole and gaster, but not hiding the sculpture.

Head slightly broader than long, occipital border straight, sides feebly convex, angles rounded. Mandibles barely as long as head, external border feebly concave in middle, inner border convex, furnished with five large sharp teeth with a small tooth between each of the larger, first two teeth small. Scapes extend beyond occipital border by barely their thickness; first and second segment of funiculus equal in length, remainder subequal. Thorax almost two and one-fourth times longer than broad. Pronotum almost twice as broad as long, strongly convex in front and on sides, flatly convex above. Mesonotum one-sixth broader than long, convex in all directions, meso-epinotal suture deep. Epinotum longer than broad, flattened transversely; in profile pronotum raised and sloping backward, straight, rounded into the rather flattened dorsum. Mesonotum convex, higher than pronotum, meso-epinotal suture deep. Epinotum convex from base to foot of declivity. Node as long as broad, slightly broader behind than in front, all faces convex; in profile top half of anterior face vertical, bottom half sloping downward and forward at an acute angle, dorsum flattened, posterior face convex and rounded into dorsum, ventral spine short and sharp. Postpetiole one-third broader than long, sides strongly convex, constriction deep and wide. First segment of gaster broader than long, much broader behind than in front, sides strongly convex. Legs robust.

Female. Length 14-15 mm. (deälated).

Colour, as in the worker.

Sculpture slightly coarser, more strongly rugose. Hair longer and more abundant. Pubescence darker, more yellowish, and more abundant on gaster. Apart from larger size and in being winged, very similar to the worker.

Habitat.—Western Australia: Tammin; Eradu (J. Clark); Dowerin (L. J. Newman).

Promyrmecia cephalotes sp. nov

Plate XIV, figs. 32-34

Worker. Length 13-14·5 mm.

Mandibles yellow, head and gaster black, antennae, thorax, node, postpetiole, a small patch on each side of first segment of gaster and all the legs yellowish-red.

Mandibles striate-punctate on apical half and a row of shallow piligerous punctures along the centre from base to apex. Head very finely striate longitudinally, very finely and densely reticulate between the striae. Pronotum finely striate and reticulate as on head but striae more spaced, longitudinal in the middle, arched on the sides. Mesonotum much more finely striate, the striae longitudinal but diverging outward in front. Epinotum rather coarsely striate transversely. Node circularly striate-rugose. Postpetiole and gaster very finely and densely punctate.

Hair yellow, short and erect on head, thorax and node, longer and more abundant on postpetiole and gaster, very short and sparse on antennae, longer and suberect on legs. Pubescence white, very fine and adpressed, longer and more abundant on gaster, where it forms a thin covering.

Head one-fifth broader than long, sides convex, occipital border straight or feebly concave. Mandibles as long as head, external border feebly convex, inner border feebly convex, furnished with five large, sharp, erect teeth. Frontal carinae as long as broad behind. Scapes extend beyond occipital border by fully their thickness; second segment of funiculus one-fourth longer than first. Thorax twice as long as broad. Pronotum twice as broad as long, strongly convex in all directions. Mesonotum one-eighth broader than long, circular, convex above. Epinotum fully one-fourth longer than broad, convex laterally; in profile pronotum and mesonotum united in an even curve with a feeble indention at the suture, top of mesonotum scarcely higher than top of pronotum and epinotum. Meso-epinotal suture deep and wide. Epinotum straight in front, broadly rounded into the declivity. Node one-fourth broader than long, convex in all directions: in profile slightly longer than high, anterior and posterior faces erect, short, broadly rounded into dorsum, ventral spine short and sharp. Postpetiole twice as broad as long, sides strongly convex. First segment of gaster one-eighth broader than long. Legs slender.

Female. Length 18·5-19 mm.

Colour as in the worker except that the first segment of gaster is entirely red at base, shading to brown at apex of segment. Wings hyaline with a yellowish tinge.

Sculpture similar but coarser.

Hair longer and more abundant.

Head one-fourth broader than long, mandibles as long as head, broader and more convex than in worker. Scapes just reach the posterior border. Node barely twice as broad as long, posterior and anterior faces straight, sides convex. Postpetiole twice as broad as long, strongly convex on front and sides. First segment of gaster one-fourth broader than long. Legs robust.

Male. Length 14 mm.

Head, pronotum, mesonotum and three last segments of gaster black. Mandibles brownish-red, antennae, legs, sides, mesonotum, epinotum, both nodes and first segment of gaster yellowish-red.

Hair white, erect, long and abundant throughout. Pubescence white, very fine and adpressed, longer and more abundant on gaster.

Head very slightly broader than long, convex behind eyes. Mandibles short and broad, furnished with three teeth. Scapes twice as long as broad and twice as long as first segment of funiculus, second segment three times longer than first. Thorax twice as long as broad. Pronotum four times broader than long, strongly convex. Mesonotum as long as broad, parapsidal furrows weakly impressed. Scutellum one-fourth broader than long, broadest in front. Epinotum twice as broad as long, convex laterally; in profile pronotum erect, strongly convex in front. Mesonotum high and convex, highest in middle. Scutellum dome-shaped. Epinotum straight on top, as long as declivity into which it is rounded. Node

one-third broader than long, convex in all directions; in profile dome-shaped, the ventral spine sharp, very short. Postpetiole one-third broader than long, sides strongly convex. First segment of gaster one-fourth broader than long. Legs long and slender.

Habitat.—South Australia: Cooper's Creek (J. G. Reuther); Killalpaninna (H. J. Hillier).

Promyrmecia hilli sp. nov

Plate XIV, fig. 35

Worker. Length 14·5 mm.

Head and last two segments of gaster black. Mandibles yellow, antennae, thorax, node, postpetiole, first two segments of gaster and the legs reddish-yellow.

Mandibles finely striate, a row of large piligerous punctures along their centre. Head finely striate longitudinally, striae spaced and densely reticulate between them. Pronotum longitudinally striate, the striae larger and more widely spaced. Mesonotum finely striate longitudinally, the striae obsolete, particularly behind. Epinotum coarsely striate transversely. Node circularly striate. Postpetiole and gaster microscopically reticulate.

Hair yellow, erect, short and sparse throughout; there are six very long hairs on dorsum of pronotum. Pubescence white, very fine and adpressed, very sparse, noticeable only on gaster.

Head very slightly broader than long, occipital border and sides feebly convex, angles broadly rounded. Mandibles as long as head, external border straight or feebly convex, inner border furnished with four large, sharp, erect teeth, with a small tooth between each, the fourth is at the basal fourth, no teeth between it and the base. Frontal carinae longer than broad. Scapes extend beyond occipital border by barely twice their thickness. Second segment of funiculus one-sixth longer than first. Thorax two and one-fourth times longer than broad. Pronotum one-third broader than long, sides strongly convex, dorsum flattened in middle. Mesonotum circular, as long as broad. Epinotum one-third longer than broad; in profile pronotum and mesonotum combined evenly convex, pro-mesonotal suture feebly indicated, meso-epinotal suture deep and wide. Epinotum weakly convex above, broadly rounded into declivity. Node as long as broad, almost circular, but slightly broader behind than in front, convex in all directions; in profile longer than high, anterior face vertical, straight, posterior face short, rounded into dorsum, anterior edge blunt, the ventral spine short and sharp. Postpetiole one-third broader than long, sides strongly convex. First segment of gaster one-fifth broader than long. Legs long and slender.

Male and female unknown.

Habitat.—Central Australia: Finke River (G. F. Hill).

Promyrmecia callima sp. nov

Plate XIV, fig. 36

Worker. Length 12·5-14 mm.

Head black, mandibles yellow, base of scapes and anterior edge of pronotum and a spot on each side of mesonotum brown, apical half of scapes, funiculus, thorax, nodes and gaster yellowish-red, legs lighter, more yellowish.

Mandibles with a row of large piligerous punctures along the centre with a slight ridge at each side forming a shallow groove. Clypeus very finely and densely punctate, with indications of very faint longitudinal striae at the sides. Head with very fine longitudinal striae widely spaced, the spaces very finely and densely

reticulate-punctate. Thorax more shining than head. Pronotum longitudinally arched striate, the striae very widely, but irregularly, spaced. Mesonotum very densely and finely reticulate-punctate, with some obsolete longitudinal striae, more clearly defined at the sides. Dorsum and declivity of epinotum transversely striate, the striae very widely spaced. Node circularly striate-rugose, in the centre the striae obsolete and almost longitudinal. Postpetiole and gaster microscopically reticulate.

Hair yellow, very long and inclined inwards on the top and underside of the mandibles, rather short and sparse on the head and thorax, with a few long fine and erect hairs sparsely scattered on thorax, more abundant on legs, longer and more abundant on apical segments of gaster, none on antennae, except a few very short at apex of scapes. Pubescence white, very short and adpressed, longer and more abundant on gaster, forming a feeble covering.

Head one-fourth broader than long, sides and occipital border convex. Mandibles slightly longer than head, external border feebly convex, inner border furnished with numerous large, sharp, erect teeth on the apical three-fourths, on the basal fourth the teeth are small, almost obsolete. Frontal carinae as long as broad in front. Scapes extend beyond occipital border by almost one-sixth of their length; second segment of funiculus one-fourth longer than first, third very slightly shorter than first, apical one-fourth longer than preceding. Thorax slightly more than twice as long as broad. Pronotum twice as broad as long, strongly convex in all directions. Mesonotum very slightly broader than long, strongly convex, the sides margined, meso-epinotal constriction deep and wide. Epinotum about one-fourth longer than broad, bluntly rounded in front, dorsum flattened. In profile pronotum convex, raised abruptly, pronotum and mesonotum combined in an even curve, mesonotum dropping behind, meso-epinotal suture deep and wide, epinotum strongly and evenly convex from base to foot of declivity. Node as long as broad, posterior border and sides strongly convex, anterior border weakly convex; in profile as long as high, anterior and posterior faces vertical, parallel, rounded into the convex dorsum, ventral spine slender and sharp. Postpetiole one-fourth broader than long, sides strongly convex, reduced in front, very narrow, constriction between postpetiole and gaster sharply impressed. First segment of gaster broader than long, strongly convex. Legs long and robust.

Female and male unknown.

Habitat.—Victoria: Kiata (Nov., 1940; I. H. Cole, J. Clark).

Resembles *P. cephalotes* Clark in the shape of the head.

Abundant on the desert country, it is known locally as the red bull-ant. The nest is inconspicuous and indicated only by a few very small holes scattered around the roots of small bushes; generally there is no mound.

Promyrmecia varians Mayr

Plate XV, figs. 67-68

Myrmecia varians Mayr, Jour. Mus. Godeff., xii, p. 94, 1876, ☿.

Myrmecia (*Myrmecia*) *varians* Emery, Gen. Insect., fasc. 118, p. 21, 1911, ☿.

Myrmecia rufonigra Crawley, Ann. Mag. Nat. Hist. (9), vii, p. 87, 1921, ☿.

Worker. Length 11-12·5 mm.

Head, thorax and gaster black, mandibles and basal half of scapes yellowish-

brown, apex and teeth more reddish, apical half of scapes, funiculus and legs yellowish-red. Node and postpetiole red.

Head finely striate longitudinally in front, more striate-rugose behind, very finely and densely punctate between the striae. Pronotum and mesonotum finely striate-rugose longitudinally. Epinotum transversely rugose. Node irregularly rugose; the spaces between the rugae on thorax and node finely and densely punctate. Postpetiole and gaster very finely and densely punctate.

Hair yellow, long and erect, abundant on mandibles, clypeus, thorax, nodes and gaster, sparse on head, none on antennae. Very short and suberect on legs. Pubescence very fine and adpressed, white, abundant throughout, forming a distinct covering on gaster but not hiding the sculpture.

Head as long as broad, sides feebly convex, occipital border straight or feebly concave, angles rounded. Mandibles one-eleventh longer than head, convex on basal third, straight on central third and from there to apex strongly convex, inner border furnished with fourteen teeth, the third, sixth, ninth, tenth, eleventh and twelfth long, sharp and curved backward, the others smaller and straight, the twelfth forms a distinct angle. Frontal carinae one-fourth longer than broad behind. Scapes extend beyond occipital border by their thickness; second segment of funiculus one-sixth longer than first, remainder subequal. Thorax fully twice as long as broad. Pronotum one-third broader than long, convex in all directions. Mesonotum one-fourth broader than long, convex. Epinotum about one-fifth longer than broad; in profile pronotum strongly convex, rising abruptly. Mesonotum convex, higher than pronotum, constriction between mesonotum and epinotum deep and wide. Epinotum convex from base to foot of declivity. Node as long as broad, very slightly broader behind than in front; in profile as high as long, anterior face short and vertical, rounded into dorsum, posterior face and dorsum united in a convexity. Ventral spine short and sharp. Postpetiole one-third broader than long, sides strongly convex, the constriction deep and wide. First segment of gaster broader than long, broader behind than in front, sides strongly convex. Legs long and slender.

Female. Length 15-16 mm.

Larger and more robust than the worker. Colour similar, sculpture coarser, pilosity longer and more abundant. Mandibles shorter and broader, teeth erect on apical half, inclined backwards on basal half. Scapes not extending to occipital border by almost their thickness. Node larger. Postpetiole hemispherical, one-third broader than long. Legs robust.

Male unknown.

Habitat.—Queensland: Peak Downs (type locality); Rockhampton; Bowen (Dr. J. Mackay); Townsville (J. P. Dodd); Gayndah (F. A. Cudmore).

The colour of this species varies considerably. On some examples the whole thorax is black, whilst on others it is red; most examples have the thorax more or less marked with red.

Re-described from a series of three specimens in National Museum collection. They were received from the Museum Godeffroy in 1888.

Promyrmecia wilsoni sp. nov.

Plate XV, fig. 66

Worker. Length 12·5-14 mm.

Head and gaster black. Mandibles, labrum and apex of clypeus yellow. Antennae, thorax, nodes and legs yellowish-red.

Head, pronotum and mesonotum and the anterior third of epinotum finely striate-rugose longitudinally, declivity of epinotum transversely rugose, node irregularly rugose. Apical half of mandibles strongly striate longitudinally, finely punctate near base. Postpetiole and gaster finely and densely punctate.

Hair yellow, fine and erect, long and abundant throughout, short and suberect on legs, none on antennae. Pubescence white, very fine and adpressed, most abundant on postpetiole and gaster, but not hiding the sculpture.

Head slightly broader than long, sides and occipital border feebly convex, angles rounded. Mandibles a fraction longer than head, external border concave in middle, inner border furnished with fifteen teeth, the third, fifth, sixth, eighth, ninth, eleventh, twelfth and fifteenth large, sharp and directed backwards. Frontal carinae longer than broad behind. Scapes extend beyond the occipital border by fully their thickness; second segment of funiculus barely one-sixth longer than first, remainder subequal. Thorax twice as long as broad. Pronotum twice as broad as long, convex in all directions. Mesonotum about one-sixth broader than long, convex; constriction between mesonotum and epinotum deep and wide. Epinotum almost as long as broad, not defined behind; in profile the pronotum and mesonotum united and evenly arched, the constriction feebly impressed. Meso-epinotal constriction deep and wide. Epinotum as high as mesonotum, evenly convex from base to foot of declivity. Node one-fifth broader than long, almost circular; in profile as high as long, anterior face short and vertical, dorsum convex, rounded into posterior face. Postpetiole almost one-fourth broader than long, sides strongly convex; constriction wide and shallow. First segment of gaster one-fourth broader than long. Legs slender.

Female and male unknown.

Habitat.—North Queensland: Mutchilba (A. D. Selby).

Four examples received from F. E. Wilson. This species resembles *P. varians* Mayr; the shape of the thorax and nodes distinguish them.

Promyrmecia shepherdi sp. nov

Plate XV, fig. 50-52

Worker. Length 10-11 mm.

Head and gaster blackish-brown, apex of pronotum and anterior coxae brown. Mandibles, anterior edge of clypeus, labrum and antennae yellow, apical segment brown; thorax, node, postpetiole and all legs reddish-yellow.

Apical half of mandibles striate, basal half reticulate-punctate. Head finely striate-rugose, densely reticulate between striae. Pronotum, mesonotum and anterior half of epinotum longitudinally striate, posterior half of epinotum and the declivity transversely striate. Node circularly rugose with a strong central longitudinal striae. Postpetiole and gaster densely and very finely punctate-reticulate.

Hair yellow, short and erect, abundant throughout, shorter and suberect on legs, none on antennae. Pubescence white, very fine and adpressed, forming a fine covering on postpetiole and gaster but not hiding the sculpture.

Head as long as broad behind eyes, occipital border straight or feebly convex, sides convex, posterior angles rounded. Mandibles as long as head, external border feebly concave, inner border straight, furnished with five large sharp teeth and two small teeth between the larger teeth. Frontal carinae as long as broad. Scapes just reach the occipital border; first and second segments of funiculus equal in length. Thorax two and one-fifth times longer than broad, pro-mesonotal suture sharply impressed, meso-epinotal suture deep and wide. Pronotum one and three-

quarter times broader than long, sides and front strongly convex, dorsum flatly convex. Mesonotum barely one-fourth broader than long, sides and front convex, posterior edge concave in middle. Epinotum strongly convex in front, almost flat laterally; in profile pronotum evenly convex from apex to base. Mesonotum evenly convex, highest in front, meso-epinotal suture deep and wide. Epinotum evenly arched from base to foot of declivity. Node very slightly broader than long, circular; in profile as high as long, anterior and posterior faces short, rounded into the convex dorsum, ventral spine short, broad and sharp. Postpetiole one-third broader than long, sides strongly convex, constriction deep and wide. First segment of gaster much broader than long, broadest behind, sides strongly convex. Legs slender.

Female. Length 14·5-15 mm.

Colour, sculpture and pilosity similar to that of the worker. Wings hyaline with a yellowish tinge, veins brown.

Head slightly broader than long, sides feebly convex behind, occipital border feebly concave, angles broadly rounded. Mandibles shorter than head, external border straight, inner border convex, teeth large. Scapes not reaching the occipital border by more than their thickness, second segment of funiculus very slightly longer than first. Mesonotum with mayrian furrows faintly indicated, parapsidal furrows sharply impressed. Node oval, fully one and one-half times broader than long. Legs robust.

Male. Length 12 mm.

Head, pronotum, mesonotum, scutellum, postpetiole and gaster brownish-black. Mandibles, antennae and legs reddish-yellow; sides, epinotum and node yellowish-red. Wings hyaline with yellowish tinge.

Sculpture as in the worker but slightly finer.

Pilosity similar but longer and slightly more abundant. Head, across the eyes, almost one-fifth broader than long, broadly convex behind. Mandibles small, narrow and sharp pointed, furnished with three small teeth. Clypeus convex above and in front. Frontal carinae as long as broad. Antennae slender. First segment of funiculus two and one-half times longer than scape, remaining segments subequal. Thorax barely twice as long as broad. Pronotum short, fully four times broader than long, strongly convex in all directions. Mesonotum one and one-half times broader than long, mayrian and parapsidal furrows strongly impressed. Scutellum almost one-third broader than long, convex in all directions. Epinotum convex transversely; in profile pronotum convex, high and vertical. Mesonotum high, evenly convex from apex to base. Scutellum hemispherical, almost four times longer than high. Epinotum evenly convex from base to foot of declivity. Node one-sixth broader than long, broadest behind, all faces convex; in profile as high as long, anterior face vertical, slightly convex, rounded into dorsum, posterior face very short rounded into dorsum; ventral spine short and sharp. Postpetiole broader than long, broadest and strongly convex at basal third; constriction broad and shallow. Gaster slender. Legs long and slender.

Habitat.—New South Wales: Broken Hill (F. W. Shepherd); Dubbo (W. W. Froggatt).

South Australia: Finke River (G. F. Hill); Murray Bridge (A. H. Elston).

Victoria: Nhill (J. Clark).

Promyrmecia goudiei sp. nov

Plate XV, figs. 48, 49

Worker. Length 12·5-14 mm.

Black, node red, in some examples the epinotum slightly reddish, mandibles, antennae and legs brown, tarsi reddish.

Head, pronotum, mesonotum and anterior fourth of epinotum finely striate-rugose longitudinally, rest of epinotum transversely rugose. Node irregularly rugose. Postpetiole and gaster and all spaces between the rugae on head and thorax very finely and densely reticulate.

Hair yellowish, long, erect and abundant throughout, shorter on legs, a few short bristle-like hairs at apex of scapes. Pubescence white, very fine and adpressed, longer and more abundant on postpetiole and gaster, forming a distinct covering but not hiding the sculpture, on the centre of gaster the pubescence is yellow.

Head as long as broad, sides feebly convex, occipital border concave in middle, angles broadly rounded. Mandibles as long as head, external border concave, inner border furnished with twelve teeth, the third, fifth, eighth, tenth and eleventh large, sharp and directed very slightly backward. Frontal carinae one-fourth longer than broad in front. Scapes just reach occipital border; first and third segments of funiculus equal in length, the second almost one-third longer, apical not as long as the two preceding combined. Thorax twice as long as broad. Pronotum twice as broad as long, strongly convex in all directions. Mesonotum one-fourth broader than long. Epinotum broadly convex in front, flatly convex laterally; in profile pronotum strongly and evenly convex from apex to base. Mesonotum higher than pronotum, abruptly convex in front and behind, flat in the middle, meso-epinotal suture deep and wide. Epinotum strongly convex from base to foot of declivity. Node slightly broader than long, convex in all directions; in profile as high as long, anterior face short and vertical, posterior face short and convex, continuous with dorsum, ventral spine short and sharp. Postpetiole one-third broader than long, sides strongly convex, constriction deep and wide. First segment of gaster one-fifth broader than long, strongly convex. Legs long and slender.

Female. Length 14 mm.

Colour, sculpture and pilosity as in the worker. Wings hyaline, nervures brown.

Head slightly broader than long. Mandibles broader and the outer border straight; the teeth larger and broader. Scapes not reaching the occipital border by fully their thickness. Thorax barely twice as long as broad. Pronotum three times broader than long, convex in all directions. Mesonotum almost one-third broader than long, broadly convex in front and above, parapsidal furrows sharply impressed, mayrian furrow feebly indicated. Scutellum one-third broader than long, with a transverse impression in the middle. Epinotum almost twice as broad as long. Node about one-fourth broader than long, strongly convex in all directions. Postpetiole twice as broad as long, strongly convex in front, constriction deep and wide. First segment of gaster fully one-fourth broader than long. Legs long and robust.

Male. Unknown.

Habitat.—Victoria: Sea Lake (J. C. Goudie); Redcliffs (W. S. Creek; J. Clark, Sept., 1939); Hattah (J. Clark); Lake Hattah (J. E. Dixon).

Promyrmecia tepperi Emery

Plate XVI, fig. 70-71

Myrmecia tepperi Emery, Rend. Accad. Sc. Bologna, p. 231, fig. 1, 1898, ♀ ♂.

Myrmecia (*Myrmecia*) *tepperi* Emery, Gen. Insect., fasc. 118, p. 20, 1911, ♀ ♂.

Worker. Length 10·5-12 mm.

Blackish-brown, gaster black. Mandibles, antennae and legs brown.

Apical half of mandibles coarsely striate, basal half finely reticulate. Head longitudinally striate, very finely and densely reticulate between the striae. Pronotum longitudinally arched striate-rugose, the striae widely separated, the spaces densely reticulate. Mesonotum more finely and closely striate longitudinally, reticulate between the striae. Epinotum coarsely striate-rugose and reticulate longitudinally on top; declivity transversely rugose. Node irregularly, almost circularly rugose. Postpetiole and gaster very finely and densely reticulate.

Hair yellow, short and erect, long and more abundant on mandibles and apical segments of gaster, short and suberect on legs. None on antennae. Pubescence yellowish, very fine and adpressed, abundant throughout; on dorsum of first segment of gaster it is more abundant but not hiding the sculpture, golden yellow on the three apical segments, long and abundant, hiding the sculpture.

Head very slightly broader than long, occipital border feebly concave, angles broadly rounded. Mandibles as long as head, external border feebly concave; apical half of inner border furnished with three large, sharp, erect teeth and five smaller; teeth on basal half short, broad and directed backward. Clypeus deeply excised in front. Scapes extend beyond occipital border by barely their thickness; second segment of funiculus one-sixth longer than first, third equal to first, remainder subequal. Thorax twice as long as broad, pronotum twice as broad as long, strongly convex in all directions. Mesonotum one-fourth broader than long, sides strongly convex, feebly convex in front and behind. Epinotum one-fifth longer than broad, flattened laterally above, sides and front feebly convex; in profile strongly convex from apex of pronotum to apex of epinotal declivity, sutures sharply impressed, mesonotum higher than pronotum and epinotum. Node one-fifth broader than long, convex in all directions; in profile anterior and posterior faces straight, vertical, dorsum feebly convex, borders rounded. Ventral spine erect, short and sharp. Postpetiole fully one-third broader than long, strongly convex in all directions, constriction wide but shallow. First segment of gaster slightly broader than long, broadest behind, sides strongly convex. Legs robust.

Female. Length 14-15 mm.

Colour, sculpture and pilosity similar to that of the worker. Larger and more robust. Wings hyaline with a yellow tinge.

Male. Length 12·5 mm. (according to Emery).

I have not seen the male, but for the sake of completeness give a translation of Emery's description as follows:

"The male differs similarly from that of *M. pilosula* by the broader petiole and by the colour of the mandibles, antennae and legs. Length 12½ mm."

Habitat.—South Australia: Tepper (? type locality); Wilpena Pound (H. Hale); Port Lincoln (J. Clark).

Western Australia: Mundaring (J. Clark); Emu Rock (H. Reynolds).

Victoria: Lake Hattah (J. E. Dixon).

Federal Capital Territory: Canberra (G. F. Hill).

The male and female were described from an unknown locality in South Australia. The worker, therefore, has been described from examples collected at Port Lincoln. In his descriptions of the male and female Emery compared them with *M. pilosula*, but they have no connection with that species; beyond size and colour there is little resemblance. This species is widely distributed in the warm mallee districts and it is surprising to find it at Canberra.

Promyrmecia clarki Crawley

Plate XVI, figs. 74-76

Myrmecia clarki Crawley, Ann. Mag. Nat. Hist., 9, ix, p. 432, 1922, ☿.
Myrmecia (*Promyrmecia*) *clarki* Wheeler, Colony-founding among Ants, p. 61, fig. 23, 1933, ☿ ♀.

Worker. Length 11-13 mm.

Black; funiculi and legs blackish-brown, tarsi lighter, mandibles yellow.

Apical half of mandibles coarsely striate, basal half finely punctate-reticulate. Head finely striate-rugose longitudinally, very finely and densely reticulate between the striae. Pronotum, mesonotum and epinotum strongly striate longitudinally, declivity transversely striate. Node longitudinally striate-rugose. Postpetiole and gaster microscopically reticulate.

Hair yellow, sparse, very short and erect, finer and suberect on legs. Very long and abundant at apex of gaster. Pubescence yellow, very fine and short, forming a distinct covering on postpetiole and gaster but not hiding the sculpture.

Head very slightly broader than long, occipital border feebly concave, sides convex, angles rounded. Mandibles slender, longer than head by their width at base, external borders concave in middle, apical half of inner border furnished with large, sharp, erect teeth, basal half with short broad teeth directed backward. Scapes extend about half their thickness beyond occipital border; second segment of funiculus one-sixth longer than first, third as long as first, remainder subequal. Thorax fully twice as long as broad. Pronotum twice as broad as long, sides and front strongly convex, dorsum flat laterally. Mesonotum one-fourth broader than long, oval, convex in all directions. Epinotum flat laterally; in profile pronotum strongly convex from apex to base, pro-mesonotal suture weakly impressed. Mesonotum flatly convex, highest behind; meso-epinotal suture deep and wide. Epinotum evenly convex from base to bottom of declivity. Node very slightly broader than long, strongly convex in all directions; in profile higher than long, stalk sloping down at an acute angle in front, anterior and posterior faces straight, vertical, dorsum feebly convex, angles rounded; ventral spine very short, erect and sharp. Postpetiole almost twice as broad as long, sides and front strongly convex; construction deep and narrow. First segment of gaster one-seventh broader than long, sides strongly convex. Legs slender.

Female. Length 16-16·5 mm.

Colour, sculpture and pilosity as in the worker. Wings hyaline, nervures brown.

Head somewhat similar but broader behind. Mandibles shorter and broader, shorter than head, external borders straight, inner border furnished with similar but larger and stronger teeth. Scapes not extending to occipital border by fully their thickness, second segment of funiculus one-fourth longer than first. Eyes not occupying half the sides, their posterior margin at middle of sides. Ocelli small but prominent. Mesonotum with well-defined mayrian furrows. Node almost one and one-half times broader than long, anterior and posterior faces short and straight, sides strongly convex. Postpetiole twice as broad as long.

Male. Length 11-12 mm.

Black. Mandibles yellow, antennae and anterior legs reddish-yellow, middle and posterior legs brown. Wings hyaline.

Head, thorax and node punctate-rugose, epinotal declivity transversely finely striate-rugose. Very finely and densely reticulate between the punctures. Postpetiole and gaster microscopically reticulate.

Hair as in the worker but not so abundant.

Head as long as broad, occipital border straight, sides convex, angles broadly

rounded. Mandibles short, almost triangular, inner border furnished with two large sharp teeth behind apex, the second forms a sharp angle to basal border. Clypeus rounded in front. Scapes short, first segment of funiculus twice as long as scapes, second segment one-fifth shorter than first, remainder subequal. Eyes large, occupying more than half the sides. Ocelli large and prominent. Thorax twice as long as broad. Pronotum five times as broad as long, strongly convex in front. Mesonotum almost cone-shaped, one-fifth broader than long, mayrian and parapsidal furrows sharply impressed. Scutellum almost as long as broad, broadest in front, strongly convex in all directions. Epinotum one-fourth broader than long, flat laterally; in profile strongly arched longitudinally. Pronotum erect, convex, mesonotum erect in front, convex from apex to base. Scutellum as high as long, dome-shaped. Epinotum convex from base to bottom of declivity. Node one-third broader than long, convex in all directions; in profile high and dome-shaped, all faces convex, ventral spine very short and sharp. Postpetiole one-third broader than long, strongly convex behind, constriction deep. First segment of gaster one-fourth broader than long. Legs slender.

Habitat.—*Western Australia*: Mundaring Weir (type locality); Margaret River; Albany; Denmark; Armadale; Perth (J. Clark).

In size and colour this species is similar to *P. pilosula*. The formation of the mandibles separates them.

Promyrmecia swalei Crawley

Plate XVI, figs. 72-73

Myrmecia harderi Forel, race *swalei* Crawley, Ann. Mag. Nat. Hist., 9, ix, p. 429, 1922, ☿.

Worker. Length 11-12·5 mm.

Head, postpetiole and gaster black, thorax and node bright red, mandibles yellow on basal half, reddish-yellow on apical half, antennae and legs brown, scapes darker.

Head longitudinally striate-rugose in front, punctate-rugose behind. Pronotum coarsely striate-rugose longitudinally. Mesonotum more irregularly rugose longitudinally. Epinotum irregularly rugose, transversely rugose on declivity. Node circularly rugose. Postpetiole and gaster microscopically reticulate.

Hair yellow, short and erect, longest on gaster, short and suberect on legs. Pubescence yellowish, very fine and adpressed, forming a thin covering on postpetiole and gaster but not hiding the sculpture.

Head very slightly broader than long, sides strongly convex behind, occipital border concave, angles rounded. Mandibles as long as head, external border straight or very feebly convex, inner border furnished on the apical half with two large, sharp, erect teeth and four very small sharp teeth, on the basal half the teeth are short and irregular more or less directed backward. Scapes not extending to occipital border by fully their thickness; first and second segments of funiculus equal in length, one-fifth longer than third, remainder subequal. Thorax fully twice as long as broad. Pronotum twice as broad as long, convex in all directions. Mesonotum one-fourth broader than long, oval. Epinotum short, subbordered in front, flattened laterally; in profile evenly convex from apex of pronotum to bottom of epinotal declivity, sutures sharp but not deep. Node very slightly broader than long, all faces convex; in profile almost square, anterior face vertical, straight, twice as high as posterior face, dorsum feebly convex, angles rounded, ventral spine short, thin and sharp. Postpetiole two-fifths broader than long, strongly convex almost hemispherical in front; constriction deep and narrow. First segment of gaster one-seventh broader than long. Legs rather slender.

Female. Length 15-16·5 mm.

Similar to the worker but larger and more robust.

Head more square behind, sides not so convex, occipital border more narrowly concave. Mandibles stronger, external border convex, teeth on apical half of inner border larger, obsolete on basal border except one large tooth near base with a small one behind it. Node oval, two-fifths broader than long, sides and dorsum convex, anterior and posterior faces straight. Postpetiole one and two-thirds times broader than long, almost oval, broadest at middle. First segment of gaster one-fifth broader than long. Legs long and stout.

Male. Unknown.

Habitat.—Western Australia: Albany (type locality, Dr. H. Swale; J. Clark); Perth; Mundaring; Ludlow; Serpentine River (J. Clark).

Described from examples collected at Albany. Crawley described this as a race of *harderi* Forel. It is not related to that species.

Promyrmecia testaceipes sp. nov.

Plate XV, fig. 69

Worker. Length 10-11 mm.

Head and gaster black, thorax and node reddish-yellow, postpetiole more or less reddish-yellow, generally with a large reddish spot on each side in front; mandibles, antennae and legs yellow, apex of mandibles and base of scapes brown.

Basal half of mandibles smooth and shining, apical half with coarse oblique striae. Head longitudinally striate, finely and densely reticulate-punctate between the striae. Clypeus almost smooth, some obsolete rugae at base. Pronotum and mesonotum longitudinally striate, epinotum and node coarsely punctate-rugose, epinotal declivity transversely rugose; the whole thorax and node finely punctate between the striae and at bottom of punctures, postpetiole and gaster microscopically punctate.

Hair yellow, short and erect, abundant throughout, long and stout on the underside of mandibles, long and fine on clypeus and apical segments of gaster, short and adpressed on antennae and legs. Pubescence whitish, very fine and close lying, most abundant on postpetiole and gaster forming a distinct covering but not hiding the sculpture.

Head one-sixth broader than long, broadest in front, sides straight or very feebly convex, occipital border concave, angles strongly rounded. Mandibles slender, as long as head, external border concave at middle, inner border furnished with three large teeth on the apical half, two smaller teeth between the larger teeth, all slightly hook-shaped, directed backwards, basal half with only faint traces of teeth except at base, where there are two large blunt teeth directed backwards. Frontal carinae longer than broad, slightly wider behind than in front, widest at middle. Scapes not reaching the occipital border by almost their thickness: first and third segments of funiculus equal in length, shorter than second, apical pointed, twice as long as second. Thorax twice as long as broad. Pronotum twice as broad as long, sides and front strongly convex, dorsum flatly convex. Mesonotum one-sixth broader than long, convex in all directions. Epinotum one-fourth longer than broad, broadly rounded in front: in profile pronotum evenly convex. Mesonotum higher than pronotum and epinotum, evenly convex, constriction between mesonotum and epinotum deep and wide. Epinotum evenly convex from base to foot of declivity. Node one-fifth broader than long, convex in all directions; in profile higher than long, top half of the anterior face and the posterior face straight,

vertical and parallel, basal half of anterior face sloping forward at an acute angle, dorsum feebly convex, ventral spine very short and slender. Postpetiole almost one third broader than long, strongly convex in all directions; constriction between postpetiole and first segment of gaster deep and wide. First segment of gaster slightly broader than long, strongly convex. Legs robust.

Female and male unknown.

Habitat.—Western Australia: Albany (J. Clark).

Resembles *P. swalei* Crawley, but more slender; the colour of the legs and antennae are very different.

Promyrmecia dixoni sp. nov

Plate XVI, figs. 77, 78

Worker. Length 9·5-10·5 mm.

Head and gaster black, mandibles yellow, antennae, thorax, nodes and legs brownish-red, base of scapes darker.

Basal half of mandibles finely punctate, apical half obliquely striate. Head longitudinally striate in front, longitudinally striate-rugose behind, interstices very finely and densely punctate. Pronotum longitudinally striate, mesonotum longitudinally striate-rugose. Epinotum and node coarsely punctate-rugose, declivity coarsely striate transversely. Postpetiole and gaster microscopically reticulate.

Hair yellow, erect, short and sparse throughout, longer and more abundant on apical segments of gaster, a few much longer and stouter on mandibles, fine, short and suberect on scapes and legs. Pubescence white, sparse except on postpetiole, gaster and legs.

Head one-sixth broader than long, sides feebly convex, occipital border feebly concave, angles rounded. Mandibles slightly longer than head, external border concave, inner border furnished with three large sharp teeth, feebly curved backward, in front and between each of these are two much smaller, behind the third large tooth the teeth are obsolete and directed backwards, the two at extreme base slightly larger. Frontal carinae as long as broad in front. Scapes not reaching the occipital border by fully their thickness, first and third segments of funiculus equal in length, very slightly shorter than second, apical almost twice as long as the preceding. Thorax twice as long as broad. Pronotum twice as broad as long, strongly convex in all directions. Mesonotum almost one-third broader than long, strongly convex, meso-epinotal constriction deep and wide. Epinotum slightly longer than broad, almost straight in front; in profile anterior face of pronotum erect, straight or feebly convex, at an acute angle, strongly rounded into the rather flat dorsum. Mesonotum higher than pronotum and epinotum, strongly convex, meso-epinotal suture sharply, but not deeply, impressed. Epinotum convex from base to foot of declivity. Node one-fifth broader than long, strongly convex in all directions; in profile one-fifth higher than long, anterior face high, straight and vertical, posterior face short and vertical, dorsum convex, dropping behind and rounded into posterior face; ventral spine short and sharp. Postpetiole almost twice as broad as long, sides, front and dorsum strongly convex, constriction narrow and deep. First segment of gaster broader than long, sides and dorsum strongly convex. Legs slender.

Female. Length 12 mm. (deälated).

Colour and pilosity as in the worker, sculpture coarser. Mandibles and scapes shorter, node and postpetiole much broader.

Male. Unknown.

Habitat.—Victoria: Eltham (J. E. Dixon, F. E. Wilson).
New South Wales: Albury (F. E. Wilson).
Federal Capital Territory: Canberra (T. Greaves).

Promyrmecia gilberti Forel

Plate XVI, figs. 79, 80

Myrmecia fulvipes Roger var. *gilberti* Forel, Rev. Suisse Zool., x, p. 6, 1910, ☿.

Myrmecia (*Pristomyrmecia*) *fulvipes* Roger var. *gilberti* Emery, Genera Insect., fasc. 118, p. 21, 1911.

Myrmecia (*pristomyrmecia*) *fulvipes* Roger race *gilberti* Forel, Bull. Soc. Vaudoise des Sc. Nat., xlix, p. 173, 1913, ☿.

Myrmecia (*Pristomyrmecia*) *regina* Santschi, Bull. Soc. Vaud. Sc. Nat., lvi, p. 465, 1928, ☿.

Myrmecia (*Promyrmecia*) *gilberti* Wheeler, Colony-founding among Ants, p. 72, 1933, ☿ ♀.

Worker. Length 9·5-15 mm.

Black, mandibles, antennae and legs brown, tarsi lighter.

Apical half of mandibles coarsely striate-rugose, basal half more finely striate-rugose, punctate between the rugae. Head finely striate-rugose, longitudinally in front, more irregularly behind, the rugae widely spaced, the interstices very finely and densely reticulate-punctate. Pronotum irregularly and coarsely striate-rugose, almost transversely. Mesonotum longitudinally striate-rugose. Epinotum punctate-rugose on top, the punctures very large and shallow, more striate-rugose transversely on declivity. Node irregularly and coarsely punctate-rugose, the punctures large. Postpetiole and gaster densely and microscopically punctate, with scattered shallow, almost obsolete, punctures, more numerous on postpetiole.

Hair grey, long and erect, abundant throughout, but longer and more numerous on mandibles and apical segments of gaster, short and suberect on legs, sparse on antennae; pubescence grey, very fine and abundant, longer and more abundant on postpetiole, yellow, and hiding the sculpture on gaster.

Head as long as broad, sides and occipital border feebly convex, angles rounded. Mandibles not as long as head, about one-ninth shorter, outer border straight or feebly concave at middle; inner border straight, furnished with twelve erect sharp teeth, long and broad on apical half, shorter and inclined backwards on basal half. Scapes not extending to occipital border by fully their thickness, second segment of funiculus very slightly longer than first, the remainder shorter, subequal to apical, which is as long as first. Thorax fully twice as long as broad. Pronotum twice as broad as long, sides and front strongly convex, dorsum feebly convex. Mesonotum one-fourth broader than long, convex in all directions, constriction between mesonotum and epinotum deep and wide. Epinotum one-sixth longer than broad, convex in all directions; in profile pronotum raised strongly and evenly convex from apex to base, mesonotum higher than pronotum and epinotum, highest in front, evenly convex, meso-epinotal constriction deep and wide, epinotum strongly and evenly convex from base to bottom of declivity, highest at anterior fourth. Node as long as broad, broadest at middle, almost twice as broad there as in front, convex in all directions; in profile as high as long, anterior face straight, vertical, rounded into dorsum, posterior face short and vertical, dorsum feebly convex, ventral spine long and sharp, broad at base. Postpetiole one-third broader than long, broadest just behind middle, strongly convex. First segment of gaster one-sixth broader than long, broader behind than in front, sides strongly convex. Legs robust.

Female. Length 16·5 mm.

Colour as on worker. Sculpture coarser, more rugose and the ground reticulation more conspicuous. Hair longer and more abundant. Pubescence brass yellow, abundant, very dense on gaster, finer and greyish-yellow on posterior half of postpetiole.

Head slightly broader than long. External border of mandible concave, inner border convex, furnished with twelve sharp erect teeth, the second, fourth, sixth, eighth and tenth much longer and broader than the others. Scapes not extending to occipital border by fully their thickness. Parapsidal and mayrian furrows feebly indicated. Node one-fifth broader than long, very slightly broader behind than in front, broader than long, broadest at middle. Postpetiole one-fourth broader than long. First segment of gaster one-eighth broader than long.

I have not seen the male but the following description by the late Dr. W. M. Wheeler is quoted for the sake of completeness:

"The male (undescribed) measures about 11 5 mm. and is more opaque than the male of *piliventris*, with much more finely rugose head, thorax and petiole. The head is proportionally smaller than in *piliventris* or *fulviculis*, the thorax, petiole and postpetiole distinctly narrower and less robust, the postpetiole as long as broad and gradually narrowed anteriorly. The pubescence on the gaster is like that of the worker; the wings are slightly smoky as in the males of *piliventris* and *fulviculis*, with yellowish-brown veins and darker brown pterostigma."

Habitat.—Queensland: Mackay (type locality, G. Turner); Townsville (F. P. Dodd, G. F. Hill); Kuah (W. M. Wheeler); Nanango (F. A. Cudmore); Burleigh Heads (Dr. C. P. Lolwani); Brisbane (H. Hacker); Bribie Island (H. Hacker); Rockhampton (Godeffroy Museum).

This species is variable in the formation of the teeth on the mandibles. At first sight it appears to belong to the *mandibularis* group; actually, however, it belongs to the *tepperi* group and almost forms a connection between *michaelseni* and *clarki*.

Promyrmecia mandibularis Smith

Plate XVII, figs. 91-93

Myrmecia mandibularis Smith, Cat. Hymn. Brit. Mus., vi, p. 145, 1852, ☿;
Mayr, Verh. Zool. Bot. Ges. Wein, xii, pp. 726-27, 1862, ☿.
Myrmecia mandibularis Smith s.sp. *aurorufa* Forel, Rev. Suisse Zool., xviii, p. 6, 1910, ☿.
Myrmecia (*Prionomyrmecia*) *mandibularis* Emery, Genera Insect., fasc. 118, pl. 1, fig. 11, 1911, ☿.
Myrmecia (*Promyrmecia*) *mandibularis* Wheeler, Colony-founding among Ants, p. 64, 1933.
Myrmecia (*Promyrmecia*) *mandibularis* Smith s.sp. *postpetiolaris* Wheeler, Colony-founding among Ants, p. 65, 1933, ☿ ♀.

Worker. Length 12-15 mm.

Black; mandibles, antennae and legs brown, tarsi reddish; on some examples the mandibles and legs quite reddish.

Shining. Mandibles longitudinally striate, coarsely so on apical third. Head longitudinally striate, with large shallow punctures between the striae behind. Pronotum, mesonotum and anterior of epinotum longitudinally striate-rugose behind, declivity transversely striate. Node longitudinally striate-rugose. Postpetiole much more finely longitudinally striate rugose in front, more punctate-

rugose behind, the rugae appear more as elongate punctures. Gaster microscopically punctate.

Hair yellow, erect, abundant throughout, very long on mandibles and gaster, short and suberect on antennae, a little longer on legs. Pubescence very fine and whitish, very close lying, longer and more abundant on postpetiole and sides of gaster forming a thin covering at middle of posterior border of postpetiole, on the gaster the pubescence is bright golden red, long, dense and adpressed, hiding the sculpture.

Head slightly broader than long, sides convex, occipital border concave, angles rounded. Mandibles fully their width at base, longer than head, parallel, external border convex, inner border furnished with four large, sharp, erect teeth at apex, behind these the teeth becoming shorter and broader to base, where they are obsolete. Scapes extend to occipital border; first and third segments of funiculus equal in length, second one and one-half times longer. Thorax fully twice as long as broad; pronotum almost twice as broad as long, sides and front strongly convex, dorsum flat; mesonotum as long as pronotum, about one-fourth broader than long, strongly convex in all directions, excision deep and narrow; epinotum one and one-half times longer than broad, bluntly rounded in front, dorsum convex; in profile pronotum evenly convex from apex to base, mesonotum slightly higher than pronotum and epinotum, highest in front, evenly convex from apex to base, epinotum twice as long as declivity into which it is rounded. Node very slightly broader than long, broadest behind middle, one-fourth broader behind than in front, anterior and posterior borders straight, sides convex; in profile slightly higher than long, anterior face vertical, feebly convex, posterior face straight, both faces rounded into the convex dorsum, ventral spine triangular, sharp pointed. Postpetiole one and one-half times broader than long, broadest at posterior third, constriction deep and wide. First segment of gaster broader than long. Legs robust.

Female. Length 15-15·5 mm.

Colour and pilosity as on the worker, sculpture similar but much coarser.

Head one-eighth broader than long, occipital border and sides feebly convex, angles broadly rounded. Mandibles slightly longer than head, external and inner borders feebly convex, inner border furnished with nine large, broad, sharp, erect teeth in front of middle; behind these the teeth are smaller and directed forward (backward in worker). Scapes barely reach occipital border. Thorax fully twice as long as broad; pronotum three times broader than long; mesonotum broader than long, broadly convex in front, mayrian furrows feebly indicated, parapsidal furrows weakly impressed; scutellum almost twice as broad as long, strongly convex; epinotum one and one-half times broader than long. Node one-fourth broader than long, broadest behind middle, anterior and posterior borders straight, sides strongly convex; in profile higher than long, anterior and posterior faces straight, vertical, rounded into the feebly convex dorsum, ventral spine triangular, short and sharp. Postpetiole one-third broader than long, strongly convex. First segment of gaster slightly broader than long, slightly broader behind than in front. Legs robust. Wings hyaline.

Male. Length 11·5-12·5 mm.

Colour as on the worker. Hair and pubescence longer and more abundant throughout. Sculpture more punctate-rugose, the bottom of punctures densely and finely punctate.

Head as long as broad, occipital border short, straight or feebly convex, sides strongly convex. Mandibles short, triangular, the angle on inner border forming a sharp tooth. Scape twice as long as first segment of funiculus, second segment three times longer than scape. Thorax twice as long as broad. Pronotum very

short, eight and one-half times longer than broad. Mesonotum slightly broader than long, broadly rounded in front, mayrian and parapsidal furrows deeply impressed. Scutellum one-third broader than long. Epinotum one-third broader than long; in profile pronotum raised vertical, convex above, mesonotum raised convex in front, feebly convex on top, mayrian furrows deeply impressed. Scutellum high, dome-shaped. Epinotum straight, as long as declivity into which it is bluntly rounded. Node one-fourth broader than long, convex in all directions; in profile higher than long, anterior and posterior faces vertical, rounded into the feebly convex dorsum, ventral spine translucent, long and sharp, broad at base, postpetiole barely one-third broader than long, broadest at basal third. First segment of gaster slightly broader than long, broader behind than in front. Legs long and robust. Wings hyaline.

Habitat.—South Australia: Adelaide (type locality); Mt. Lofty (A. H. Elston). *Western Australia*: Enni Park (H. Reynolds); Perth; Mundaring; Collie; Albany (J. Clark).

Promyrmecia laevinodis sp. nov.

Plate XVII, figs. 94, 95

Worker. Length 11-14 mm.

Black; mandibles, antennae and legs reddish-brown.

Shining. Mandibles finely striate longitudinally, with shallow, elongate punctures between the striae. Head finely striate longitudinally, interstices wide, with large, shallow punctures. Pronotum and mesonotum longitudinally striate, coarser than on head. Epinotum and node coarsely and irregularly rugose, declivity transversely striate. Postpetiole and gaster microscopically punctate; on some examples indications of a few large punctures, very feeble and obsolete.

Hair yellow, erect, rather sparse on head and thorax, longer and more abundant on postpetiole and gaster, short and suberect on legs. Pubescence white, very fine and adpressed, longer and more abundant on postpetiole and sides of gaster; on the dorsum of gaster it is bright, reddish-yellow, long, hiding the sculpture.

Head one-seventh broader than long, sides feebly convex, occipital border straight or feebly concave, angles broadly rounded. Mandibles slightly longer than head, about half their breadth longer, external border straight at middle, convex at basal fourth, inner border furnished with five erect, sharp teeth on apical fourth, behind these the teeth obsolete, almost effaced. Scapes extend beyond occipital border by their thickness; first and third segments of funiculus equal in length, second one-fourth longer than first. Thorax fully twice as long as broad. Pronotum barely twice as broad as long, almost circular, dorsum flat. Epinotum as long as pronotum, one-third broader than long, oval; excision deep and narrow. Epinotum one and one-half times longer than broad; in profile evenly convex from apex of pronotum to base of mesonotum, excision deep, narrow at bottom; epinotum feebly convex in front, strongly convex into declivity behind. Node one-sixth broader than long, broader behind than in front, sides strongly convex, anterior and posterior borders feebly convex; in profile very slightly higher than long, anterior and posterior faces straight and vertical, rounded into the feebly convex dorsum, ventral spine triangular, half as long as broad at base, bluntly pointed. Postpetiole one-fourth broader than long, broadest at posterior fourth, constriction deep and wide. First segment of gaster slightly broader than long. Legs long and robust.

Female. Length 15-16 mm.

Colour and pilosity as on the worker. Sculpture much coarser.

Head broader than long, occipital border feebly concave. Mandibles shorter than head, broad, external borders straight in middle, inner border convex, furnished

with eight or nine large, broad, sharp, erect teeth and behind these three or four shorter and blunt directed forwards. Scapes not extending to the occipital border by almost their thickness. Thorax twice as long as broad; pronotum three and one-half times broader than long, dorsum feebly convex. Mesonotum one-sixth broader than long, parapsidal furrows feebly indicated. Scutellum one-third broader than long. Epinotum slightly broader than long, feebly convex transversely; in profile pronotum and mesonotum raised and evenly convex to base of mesonotum, pro-mesonotal suture feebly impressed. Scutellum raised slightly above mesonotum, convex. Epinotum convex from base to foot of declivity. Node one-seventh broader than long, broadest behind middle, anterior and posterior borders straight, sides convex. Postpetiole one and one-half times broader than long, strongly convex in all directions, constriction deep but not wide. First segment of gaster one-ninth broader than long. Legs robust. Wings hyaline.

Male. Unknown.

Habitat.—Western Australia: Armadale; Albany; Bunbury (J. Clark).

South Australia: Lucindale; Melrose (A. M. Lea); Kangaroo Island (A. Campbell).

Victoria: Mallee (J. E. Dixon).

Similar to *P. mandibularis* Smith, but separated by the smooth postpetiole.

Promyrmecia piliventris Smith
Plate XVII, figs. 84-86

Myrmecia piliventris Smith, Cat. Hymn. Brit. Mus., vi, p. 146, 1858, ☿ ; Roger, Berl. Ent. Zeitschr., v, p. 36, 1860-61, ☿ ; Mayr, Verh. Zool. Bot. Ges. Wien, xii, p. 727, 1862, ☿ ; Jour. Mus. Godeffroy, xii, p. 93, 1876, ☿ ♀.

Myrmecia (*Pristomyrmecia*) *piliventris* Emery, Genera Insect., fasc. 118, p. 21, 1911, ☿ ♀.

Myrmecia (*Promyrmecia*) *piliventris* Wheeler, Colony-founding among Ants, p. 67, 1933, ☿.

Worker. Length 10-15·5 mm.

Black; mandibles, antennae and legs dark brown, tarsi lighter, more reddish.

Shining. Mandibles obliquely striate on apical half, more finely striate and punctate on basal half. Head longitudinally striate in front, more striate-rugose behind, the interstices very finely reticulate. Pronotum, mesonotum, anterior epinotum and node longitudinally striate-rugose, declivity transversely rugose, more coarsely than on head, interstices finely reticulate. Postpetiole and gaster microscopically punctate.

Hair yellowish, erect and abundant, particularly long on mandibles, clypeus and apical segments of gaster, short and suberect on legs. Pubescence greyish, very fine and close-lying on antennae and legs, yellow, long and forming a dense covering on gaster and posterior of postpetiole.

Head one-eighth broader than long, sides straight, occipital border feebly concave, angles broadly rounded. Mandibles slightly longer than head, parallel, straight or feebly convex on external border, inner border with five strong, sharp, erect teeth on apical fourth, behind these the teeth short and directed backwards, sawtooth-like. Scapes extend to occipital border; first and third segments of funiculus equal in length, second almost one-fourth longer. Thorax fully twice as long as broad. Pronotum almost twice as broad as long, sides and front strongly convex, dorsum flattened. Mesonotum as long as pronotum, one-fourth broader than long, dorsum feebly convex, meso-epinotal excision deep and wide. Epinotum one-fifth longer

than broad, almost flat transversely; in profile pronotum raised, strongly convex from apex to base. Mesonotum convex, highest in front and slightly higher than pronotum and epinotum, excision deep, sharp at bottom. Epinotum convex from base to first of declivity. Node very slightly broader than long, broadest at middle, broader behind than in front; in profile slightly higher than long, anterior and posterior faces straight and vertical, both rounded into the feebly convex dorsum, ventral spine long, thin and sharp, as long as broad at base. Postpetiole one-third broader than long, strongly convex in all directions, constriction deep but not wide. First segment of gaster very slightly broader than long, broader behind than in front. Legs long and robust.

Female. Length 16-20 mm.

Colour as on the worker. Sculpture coarser. Pilosity more abundant and longer, the pubescence on postpetiole and gaster longer and more abundant, bright brass yellow.

Head one-ninth broader than long, sides and occipital border straight, angles rounded. Mandibles much shorter than head, external borders straight or feebly convex, inner border strongly convex, furnished with twelve long, sharp, erect teeth, broad at base. Scapes not extending to occipital border by fully their thickness. Node one-third broader than long, broadest just behind middle, anterior and posterior borders straight, sides convex. Postpetiole three-fifths broader than long, strongly convex. First segment of gaster broader than long, broadest in front of middle, broader behind than in front. Wings with a yellow tinge.

Male. Length 11·5 mm.

Colour, and pilosity, as in the worker, sculpture more punctate-reticulate.

Head as broad as long, strongly arched from behind, semi-circular. Mandibles triangular, inner border furnished with one large sharp tooth at basal angle. Scapes not extending to posterior border of eyes, twice as long as first segment of funiculus, second segment three times longer than scape. Thorax barely twice as broad as long. Pronotum very short, semi-circular. Mesonotum broader than long, parapsidal furrows sharply impressed, mayrian furrow sharply impressed in front, feebly impressed behind. Scutellum slightly broader than long, dome-shaped. Epinotum one-third broader than long, strongly convex. Node as long as broad, slightly broader behind, almost circular. Postpetiole one-fifth broader than long, broadest behind middle, bluntly rounded in front, constriction deep and wide. First segment of gaster broader than long, sides strongly convex. Legs slender. Wings with a yellowish tinge.

Habitat.—New South Wales: Sydney; Thornleigh; Peak Hill (W. W. Froggatt).
Queensland: Stanthorpe; Fletcher (E. Sutton).
Tasmania: Burnie (N. Howes).
Victoria: Frankston (C. Barrett); Belgrave (J. Clark); Eltham (J. E. Dixon); Broadmeadows (F. P. Spry).

The specimens from Tasmania are identical in every detail with those from Sydney.

Promyrmecia piliventris Smith s.sp. *rectidens* Forel

Plate XVII, fig. 87

Myrmecia piliventris Smith var. *rectidens* Forel, Rev. Suisse Zool., xviii, p. 5, 1910.

Myrmecia (Pristomyrmecia) piliventris Smith var. *rectidens* Emery, Genera Insect., fasc. 118, p. 21, 1911.

Myrmecia (*Promyrmecia*) *piliventris* Smith s.sp. *rectidens* Wheeler, Colony-founding among Ants, p. 68, 1933.

Worker. Length 9·5 mm.

Mandibles, antennae and legs reddish-brown, head, thorax and node brownish-black, postpetiole and gaster brown.

Shining. Mandibles with a few coarse striae on apical third, almost smooth behind, a few shallow elongate punctures. Head finely striate longitudinally. Pronotum and mesonotum longitudinally striate, much coarser than on head. Epinotum coarsely rugose, longitudinal on anterior fourth, irregular behind, transverse on declivity. Node coarsely and irregularly rugose, postpetiole and gaster microscopically punctate.

Hair yellow, short and erect, sparse throughout, long and more numerous on clypeus, mandibles and apical segments of gaster, short and suberect on scapes and legs, longer at apex of femur. Pubescence not apparent except on postpetiole and gaster, where it forms a dense golden covering hiding the sculpture.

Head almost as long as broad, sides feebly convex, occipital border feebly concave, angles broadly rounded. Mandibles fully their width longer than head, straight and parallel, bent at basal fourth, inner border furnished with five large, sharp, erect teeth slightly inclined backward; behind these is a series of very small backward-directed denticles. Scapes extend to occipital border, first and third segments of funiculus equal in length, fully half as long as second. Thorax fully twice as long as broad. Pronotum almost twice as broad as long, dorsum flattened. Mesonotum as long as pronotum, one-fourth broader than long, meso-epinotal constriction deep and narrow. Epinotum one-fifth longer than broad, dorsum feebly convex; in profile mesonotum raised above level of pronotum and epinotum, excision deep and narrow; pronotum evenly convex from apex to base; mesonotum highest in front, evenly convex; epinotum evenly convex from base to foot of declivity. Node as long as broad, anterior and posterior faces straight, vertical, rounded into the feebly convex dorsum, ventral spine long and thin, not as long as wide at base. Postpetiole one and three-fourths times broader than long, strongly convex, constriction wide but not deep. First segment of gaster one-fifth broader than long. Legs slender.

Male and female unknown.

Habitat.—New South Wales: ? Kingstown (W. W. Froggatt); Uralla (W. W. Froggatt).

Victoria: *Ararat* (G. F. Hill).

Re-described from a co-type received some years ago from Mr. Froggatt. The locality label on the co-type states *King's Sound 142* in Froggatt's writing. This is undoubtedly an error as this form is found plentiful around Kingstown and Uralla in New South Wales. Forel gives the locality as Kingstown, Australia

Promyrmecia piliventris Smith var. *femorata* Santschi

Plate XVII, figs. 88-90

Myrmecia (*Pristomyrmecia*) *piliventris* Smith var. *femorata* Santschi, Bull. Soc. Vaud. Sc. Nat., lvi, p. 466, 1928, ☿.

Myrmecia (*Promyrmecia*) *fulvipes* Roger var. *femorata* Wheeler, Colony-founding among Ants, p. 70, 1933, ☿.

This form differs from *piliventris* only in the colour of the coxae and femora, red on some examples. Many specimens from the same nests cannot be separated

from the typical form, the colour and sculpture being identical. It can be regarded only as a slightly colour variety and the name retained to prevent future confusion. The female and male also are included in the above remarks as both are distinguished only by the red femora.

Habitat.—Victoria: Frankston (C. L. Barrett); Belgrave; Ferntree Gully (J. E. Dixon, J. Clark); Eltham (J. E. Dixon).

Promyrmecia luteiforceps Forel

Plate XVII, fig. 96

Myrmecia (*Pristomyrmecia*) *fulvipes* Roger r. *gilberti* Forel var. *luteiforceps* Forel, Arkiv. f. Zool., ix (16), p. 9, 1915, ☿.

Myrmecia (*Promyrmecia*) *gilberti* Forel var. *luteiforceps* Wheeler, Colony-founding among Ants, p. 74, 1933, ☿.

Worker. Length 12 mm.

Black; mandibles yellow, antennae and legs brown, tarsi reddish.

Apical half of mandibles obliquely striate, basal half smooth and shining. Head finely striate-rugose longitudinally in front, irregularly rugose behind, interstices densely punctate-reticulate. Pronotum and mesonotum longitudinally striate-rugose, more coarsely than on head, epinotum and node irregularly punctate-rugose, the declivity transversely rugose, interstices and bottom of punctures densely punctate-reticulate. Postpetiole and gaster densely and finely punctate.

Hair yellowish, short and erect, long and abundant on mandibles, clypeus and gaster, none on antennae, very short and suberect on legs. Pubescence yellowish, sparse except on gaster, where it forms a dense covering, some scattered pubescence on middle of posterior fourth of postpetiole.

Head slightly broader than long, sides feebly convex, occipital border straight or feebly concave, angles rounded. Mandibles longer than head, parallel, external border straight, inner border furnished with five large, sharp, erect teeth on apical third, on the basal two-thirds the teeth short, sharp and directed backwards. Scapes not extending to occipital border by their thickness; second segment of funiculus one-fifth longer than first. Thorax fully twice as long as broad. Pronotum one and one-half times broader than long, strongly convex; mesonotum one-third broader than long, oval, meso-epinotal excision deep. Epinotum one-fourth longer than broad, feebly convex on top; in profile, dorsum of the three segments forming a straight line, meso-epinotal excision deep and wide, pro-mesonotal suture feebly indicated, pronotum strongly convex in front, forming a straight surface with mesonotum behind, mesonotum dropping convex at excision; epinotum raised slightly convex in front, dorsum flattened, rounded into declivity. Node a fraction broader than long, almost circular; in profile as high as long, anterior face vertical, feebly convex rounded into dorsum, posterior face very short, broadly rounded into dorsum, ventral spine short and sharp, half as long as broad at base. Postpetiole barely one-third broader than long, almost semi-circular in front. First segment of gaster one-sixth broader than long, broader behind than in front. Legs slender.

Male and female unknown.

Habitat.—North Queensland: Herberton (E. Mjöberg).

Described and figured from a co-type. Forel described this as a variety of *gilberti*, stating that the yellow jaws are the main reason for separating them. The only features in common on both forms is the pubescence on postpetiole and gaster.

Promyrmecia fulviculis Forel

Plate XVII, fig. 97

Myrmecia (*Pristomyrmecia*) *fulvipes* Roger r. *fuliculis* Forel, Bull. Soc. Vaud. Sc. Nat., xlix, p. 174, 1913, ☿.

Myrmecia (*Promyrmecia*) *fulvipes* Roger s.sp. *fulviculis* Wheeler, Colony-founding among Ants, p. 70, 1933, ☿.

Worker. Length 13-14·5 mm.

Head, thorax and node black, mandibles and antennae reddish-brown, postpetiole and anterior two-thirds of first segment of gaster brown, apical third of first segment and the following segments yellowish, legs, including coxae, reddish-yellow.

Mandibles coarsely and obliquely striate on apical third, finely and longitudinally striate behind. Head finely and longitudinally striate-rugose, irregularly punctate-rugose behind, striae widely spaced, the spaces densely reticulate. Thorax much more coarsely rugose, the rugae almost longitudinal on pronotum and mesonotum, irregularly on epinotum and node. Postpetiole and gaster microscopically reticulate.

Hair yellow, erect, long and fine throughout, coarser, shorter and suberect on antennae and legs. Pubescence whitish, very fine and close lying, very dense, yellow, long and adpressed on postpetiole and gaster, where it forms a dense golden covering hiding the sculpture.

Head very slightly broader than long, sides and occipital border straight, angles broadly rounded. Mandibles slightly longer than head, external border straight or feebly convex, inner border furnished on apical third with five large, sharp, erect teeth, from these to base the teeth widely spaced, short and directed backward. Scapes extend to occipital border; first and third segments of funiculus equal in length, second two and one-fourth times longer than first. Thorax fully twice as long as broad. Pronotum one-third broader than long, strongly convex, mesonotum one-fifth broader than long, oval, epinotum about one-third longer than broad; in profile mesonotum scarcely raised above level of pronotum and epinotum, excision deep, sharp at bottom, pronotum and mesonotum forming an even arch, mesonotum dropping abruptly behind. Epinotum feebly convex on dorsum, almost twice as long as declivity into which it is broadly rounded. Node one-sixth broader than long, broadest at middle, sides and posterior border strongly convex, anterior and posterior faces straight and vertical, rounded into the convex dorsum, ventral spine triangular, sharp, half as long as broad at base. Postpetiole one-third broader than long, strongly convex in all directions, constriction deep and wide. First segment of gaster slightly broader than long. Legs robust.

Male and female unknown.

Habitat.—New South Wales: Sydney (A. M. Lea); Como (E. H. Zeck); Lismore (C. F. Deuquet).

Queensland: Brisbane; Bribie Island (H. Hacker); Fletcher; Stanthorpe (E. Sutton).

The type of this species was collected at Sydney, not Tasmania, as stated in Forel's description. Co-types received some years ago from Froggatt had Lea's label attached in addition to one in Froggatt's handwriting with the name Tasmania and his number to Forel. Lea sent many specimens of New South Wales ants from Hobart to Froggatt for identification and apparently Froggatt did not notice Lea's label. This species differs too much from both *P. fulvipes* and *P. piliventris* to be attached to either.

Promyrmecia fulvipes Roger

Plate XVI, figs. 81-83

Myrmecia fulvipes Roger, Berl. Ent. Zeitschr., v, p. 36, 1861, ☿ ; Mayr, Verh. Zool. Bot. Ges. Wien, xii, p. 726, 1862, ☿ ; Jour. Mus. Godeffroy, xii, p. 93, 1876, ☿.

Myrmecia (*Pristomyrmecia*) *fulvipes* Emery, Genera Insect., fasc. 118, p. 21, 1911; Forel, Bull. Soc. Vaud. Sc. Nat., xlix, p. 173, 1913, ☿.

Myrmecia (*Promyrmecia*) *fulvipes* Wheeler, Colony-founding among Ants, p. 69, 1933, ☿.

Worker. Length 10-12 mm.

Black; mandibles and antennae brown, coxae and legs reddish-yellow, tarsi slightly darker.

Shining. Apical half of the mandibles obliquely striate-rugose, basal half almost smooth, with large, shallow, elongate punctures. Head longitudinally striate-rugose in front, more punctate-rugose behind, the interstices finely punctate-reticulate. Pronotum, mesonotum, anterior fourth of epinotum and node more coarsely striate-rugose, more or less longitudinally, remainder of epinotum irregularly rugose, declivity transversely striate-rugose. Postpetiole and gaster micro-scopically punctate.

Hair yellow, erect, rather short except on mandibles, clypeus and apical segments of gaster, much shorter and suberect on antennae and legs. Pubescence greyish-yellow on postpetiole, longer and more abundant on middle of posterior third; brass yellow on gaster, longer and more abundant, forming a dense covering.

Head one-tenth broader than long, sides and occipital border feebly convex, angles rounded. Mandibles one-tenth shorter than head, parallel, external border straight, inner border furnished with seven large, sharp, erect teeth on apical half, short and directed backward, sawtooth-like on basal half. Scapes just reach occipital border; first and second segments of funiculus of equal length, apical slightly longer. Thorax twice as long as broad. Pronotum twice as broad as long, convex in all directions. Mesonotum one-third broader than long, strongly convex in all directions; meso-epinotal constriction deep and narrow. Epinotum one-third longer than broad, feebly convex transversely; in profile mesonotum scarcely higher than pronotum and epinotum, meso-epinotal constriction deep but not wide, pronotum raised, strongly convex. Mesonotum flatly convex, highest behind, epinotum strongly convex from base to foot of declivity. Node one-fifth broader than long, broadest just behind middle, strongly convex in all directions; in profile higher than long, anterior face straight, sloping gently backward, rounded into the feebly convex dorsum, posterior face short, sloping slightly backward, rounded into dorsum, ventral spine long and sharp, as long as broad at base. Postpetiole one and one-half times broader than long, strongly convex, constriction behind deep and wide. First segment of gaster one-tenth broader than long, broader behind than in front. Legs long and stout.

Female. Length 15 mm.

Colour, sculpture and pilosity as in the worker.

Head fully one-sixth broader than long. Mandibles shorter than head, external border feebly concave at middle, inner border strongly convex, furnished with nine large, sharp, erect teeth on apical three-fourths, from the ninth to base the teeth smaller and broad. Node fully one-fourth broader than long, oval. Postpetiole one-third broader than long. First segment of gaster one-fourth broader than long. Legs robust. Wings hyaline, slightly yellowish.

Male. Length 10·5 mm.

Colour as in the worker. Sculpture similar but finer. Hair longer and more abundant throughout.

Head very slightly broader than long, sides and occipital border convex. Mandibles short, triangular, inner border with a sharp cutting edge, without teeth. Scapes extend slightly beyond middle of eyes; second segment of funiculus two and one-half times longer than scapes and eight times longer than first segment. Thorax fully twice as long as broad. Pronotum short, strongly convex. Mesonotum slightly broader than long, parapsidal and mayrian furrows impressed. Scutellum one-fifth broader than long, strongly convex in all directions. Epinotum almost twice as broad as long, convex transversely; in profile pronotum almost vertical, convex above. Mesonotum evenly convex from apex to base, highest at base, mayrian furrows distinct. Scutellum high, its base level with pronotum and epinotum, dome-shaped. Epinotum short, convex from base to foot of declivity. Node one-fifth broader than long, broader behind than in front, broadest at middle; in profile higher than long, anterior face straight and vertical, dorsum convex, rounded into short posterior face, ventral spine long, slender and sharp. Postpetiole one-third broader than long, constriction wide and deep. First segment of gaster one-fifth broader than long, broader behind than in front. Legs slender. Wings hyaline, slightly yellowish.

Habitat.—South Australia: Murray River (S. W. Fulton).

Victoria: Ferntree Gully; Millgrove; Beaconsfield; South Morang; Grampians; Gellibrand (J. Clark).

Tasmania: Hobart (A. M. Lea); Wynyard (F. A. Cudmore); Trevallyn (V. V. Hickman); St. Patrick's River (F. A. Cudmore).

New South Wales: Batlow (W. W. Froggatt); Barrington Tops (H. J. Carter); Uralla (W. W. Froggatt); Sydney (A. Musgrave).

The following two forms are not represented in our collection, but for convenience Wheeler's descriptions are given below.

Myrmecia (*Promyrmecia*) *fulvipes* Roger s.sp. *barbata* Wheeler, Colony-founding among Ants, p. 71, 1933, ☿ ♀.

Worker. Length 12-14·5 mm.

Head broader than in the preceding forms, especially behind, and therefore more rectangular. Mandibles somewhat shorter, stouter and distinctly curved, the subapical teeth smaller. Petiole and postpetiole as in *fulviculis,* but the former more sharply truncated anteriorly. Surface of head, thorax and petiole somewhat more shining, with more regular rugosity. Pilosity more abundant, conspicuously long on the gula. Pubescence dense, present on the postpetiole and gaster as in the typical *fulvipes,* but fine and dull, greenish-golden as in *M. piliventris.* Black; antennae and mandibles red; legs reddish-yellow as in *fulviculis*; sting black.

Female (deälated). Length 14·5 mm.

Very similar to the worker. Mandibles broader and somewhat shorter, with subapical teeth larger and occupying fully one-half of the inner border. Thorax more robust, with larger mesonotum and scutellum and shorter epinotum. Petiole and postpetiole broader. Gular hairs shorter; pubescence on abdomen as in the worker and fully as dense on the postpetiole as on the gaster.

Described from ten workers from Dorrigo, New South Wales (W. Heron), and a worker and female from Belgrade.

Promyrmecia fulvipes Roger s.sp. *coelatinoda* Wheeler

Myrmecia (*Promyrmecia*) *fulvipes* Roger s.sp. *coelatinoda* Wheeler, Colony-founding among Ants, p. 72, 1933, ☿.

Worker. Length about 13 mm.

Mandibles as in *barbata*, but the subapical teeth worn away, the serrate basal denticles very minute and indistinct. Petiole as in *barbata*, postpetiole one and one-half times as broad as long, semi-circular anteriorly, its posterior border somewhat emarginate in the middle. Gaster slender, the first segment nearly as long as broad. Sculpture as in *barbata*, but much more of the posterior portion of the epinotum transversely and the petiolar node more coarsely rugose. Unlike all the preceding forms of *fulvipes*, the postpetiole is sculptured, being sharply, longitudinally rugulose, with elongate foveolae between the rugules as in *M. mandibularis rugosa*. Pilosity somewhat less abundant than in *fulviculis*, the pubescence of the pelisse on the gaster of the same bright golden colour, but coarser, longer and less distinctly converging at the mid-dorsal line. On the postpetiole there is only a minute patch of golden pubescence at the emargination of the posterior border. Mandibles, antennae, legs and gaster red; head, thorax and petiole blackish-red.

Described from a single specimen from Belair, South Australia (J. W. Haacke). This subspecies is readily distinguished from all the other forms of *fulvipes* by its colour and its sculptured and posteriorly emarginate postpetiole.

Explanation of Plates

Plate XII

Dorsal and lateral view of body.

Fig. 1. Promyrmecia aberrans Forel. Worker.
2. nobilis sp. nov. Worker.
3. nobilis sp. nov. Female.
4. nobilis sp. nov. Male.
5. froggatti Forel. Worker.
6. maura Wheeler. Worker.
7. maura Wheeler. Female.
8. eupoecila sp. nov. Female.
9. greavesi sp. nov. Female.
10. picta Smith. Worker.
11. picta Smith. Female.
12. picta Smith. Female (ergatoid).
13. picta Smith. Male.
14. fucosa Clark. Female.
15. fucosa Clark. Worker.
16. fucosa Clark. Male.

Plate XIII

17. Promyrmecia michaelseni Forel. Worker.
18. michaelseni Forel. Female.
19. queenslandica Forel. Worker.
20. ruginodis sp. nov. Worker.
21. ruginodis sp. nov. Female.
22. ruginodis sp. nov. Male.
23. chrysogaster sp. nov. Worker.

24. Promyrmecia cydista sp. nov. Worker.
25. chasei Forel. Worker.
26. chasei Forel. Female.
27. chasei Forel. Male.
28. harderi Forel. Worker.
29. harderi Forel. Female.
30. occidentalis sp. nov. Worker.
31. occidentalis sp. nov. Female.

PLATE XIV

32. Promyrmecia cephalotes sp. nov. Worker.
33. cephalotes sp. nov. Female.
34. cephalotes sp. nov. Male.
35. hilli sp. nov. Worker.
36. callima sp. nov. Worker.
37. pilosula Smith. Worker.
38. pilosula Smith. Female.
39. pilosula Smith. Male.
40. scabra sp. nov. Worker.
41. scabra sp. nov. Female.
42. celaena sp. nov. Worker.
43. maloni sp. nov. Worker.
44. elegans sp. nov. Worker.
45. elegans sp. nov. Female.
46. opaca sp. nov. Worker.
47. opaca sp. nov. Female.

PLATE XV

48. Promyrmecia goudiei sp. nov. Worker.
49. goudiei sp. nov. Female.
50. shepherdi sp. nov. Worker.
51. shepherdi sp. nov. Female.
52. shepherdi sp. nov. Male.
53. dichospila Clark. Worker.
54. dichospila Clark. Female.
55. dichospila Clark. Male.
56. urens Lowne. Worker.
57. urens Lowne. Female.
58. urens Lowne. Male.
59. infima Forel. Worker.
60. infima Forel. Female.
61. infima Forel. Male.
62. nigra Forel. Worker.
63. nigra Forel. Female.
64. exigua sp. nov. Worker
65. rubicunda sp. nov. Worker.
66. wilsoni sp. nov. Worker.
67. varians Mayr. Worker.
68. varians Mayr. Female.
69. testaceipes sp. nov. Worker.

PLATE XVI

70. Promyrmecia tepperi Emery. Worker.
71. tepperi Emery. Female.
72. swalei Crawley. Worker.
73. swalei Crawley. Female.
74. clarki Crawley. Worker.
75. clarki Crawley. Female.
76. clarki Crawley. Male.
77. dixoni sp. nov. Worker.
78. dixoni sp. nov. Female.
79. gilberti Forel. Worker.
80. gilberti Forel. Female.
81. fulvipes Roger. Worker.
82. fulvipes Roger. Female.
83. fulvipes Roger. Male.

PLATE XVII

84. Promyrmecia piliventris Smith. Worker.
85. piliventris Smith. Female.
86. piliventris Smith. Male.
87. rectidens Forel. Worker.
88. femorata Santschi. Worker.
89. femorata Santschi. Female.
90. femorata Santschi. Male.
91. mandibularis Smith. Worker.
92. mandibularis Smith. Female.
93. mandibularis Smith. Male.
94. laevinodis sp. nov. Worker.
95. laevinodis sp. nov. Female.
96. luteiforceps Forel. Worker.
97. fulviculus Forel. Worker.


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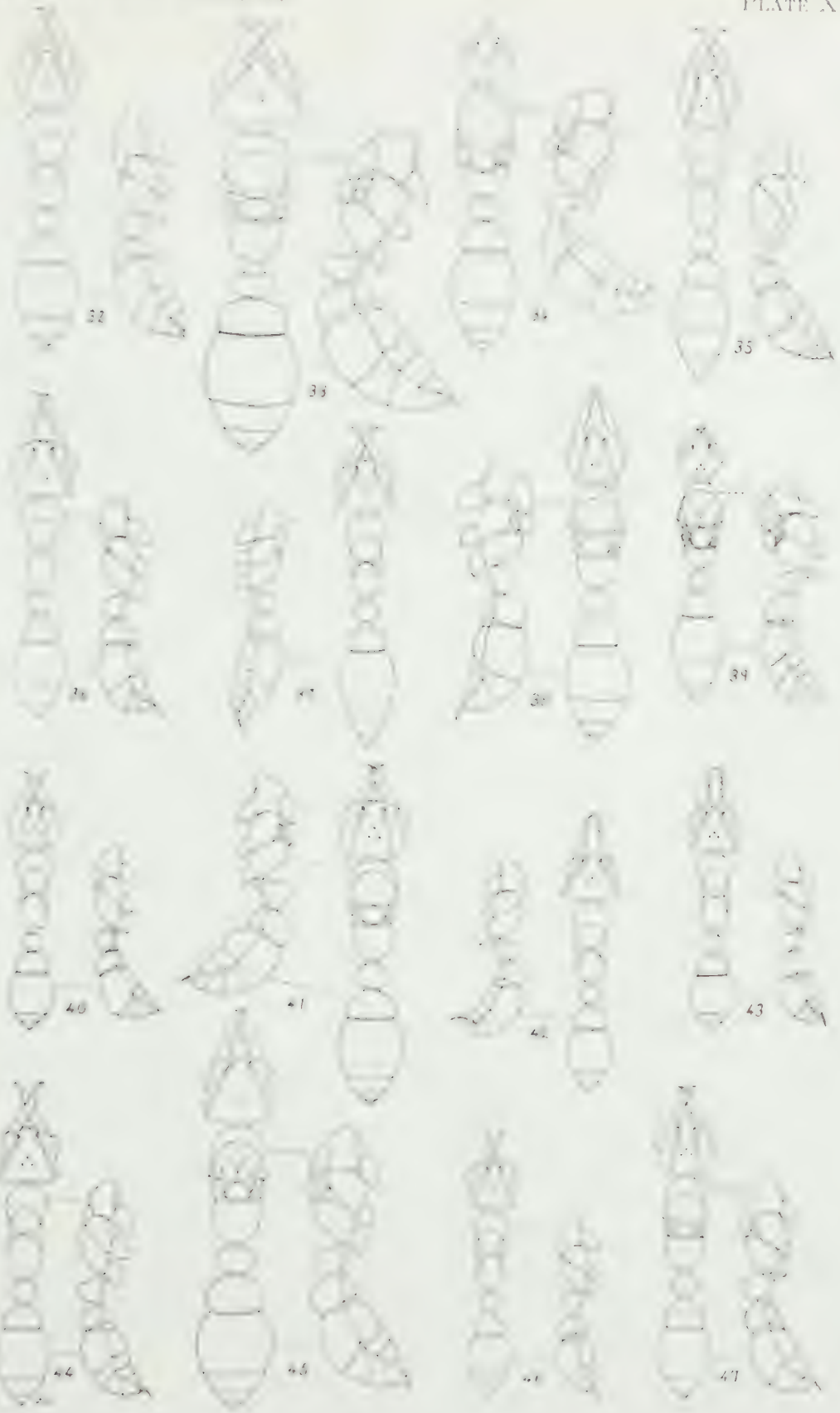

A NEW SPECIES OF *PAUROPUS* FROM VICTORIA

By O. W. Tiegs, D.Sc.,
Associate-Professor of Zoology, University of Melbourne

Although Pauropoda are of widespread occurrence in Australia, they have not attracted much attention from systematists, probably owing to their small size and obscure habitat. Nearly thirty years ago Harrison (2) described five species, including a member of the remarkable genus *Eurypauropus*, from the neighbourhood of Sydney; since then the list of Australian species has not, as far as I am aware, been added to.

The species which is described in the present paper is one that I have obtained in large numbers in the damp mountainous forest country at Belgrave in Victoria, and I am using it at present as material for the study of the embryology of these peculiar arthropods. As it seems to be distinct from any other form hitherto recorded, a taxonomic description is needed.

In the following account I have fairly closely followed the method of description worked out by Hansen (1); for when types are not accessible, comparison with his species can be made only on the basis of those characters to which he specifically refers. The nomenclature adopted is also based on that of Hansen.

Class **PAUROPODA** Lubbock, 1868
Order **HETEROGNATHA** Saussure et Humbert, 1872
Family **PAUROPODIDAE** Lubbock, 1868
Genus PAUROPUS Lubbock, 1868

Pauropus silvaticus sp. nov

Size. The largest specimens encountered measured 1·2 mm. in length, the smallest with full number of legs, about 0·86 mm.; the average length based on a measurement of twelve individuals, is 0·97 mm. Average breadth about 0·23 mm.

Head (fig. 1). The distance between the "ocular areas" on the dorsal surface of the head is about the same as the length of the areas.

The head is itself completely free from pubescence; its setae are, however, all covered with a very delicate, just perceptible pubescence.

These setae are, as usual, disposed in four transverse rows: (i) An anterior, mainly pre-antennal, row of setae, of which one lies unpaired in the median line. Five of these setae are clavate, measuring ·02 mm. in length; but the two most lateral setae are delicate and cylindrical, and are not longer than the clavate setae. (ii) The second row is post-antennal, and comprises eight setae, of which six are clavate and are similar to those of the first row, while the two most lateral setae are cylindrical, and do not exceed the clavate setae in length. This row ends just in front of the inner angles of the "ocular areas." (iii) The third row consists of six widely spaced setae, of which four are clavate, while the two most lateral,

arising from the sides of the head, are long and cylindrical, measuring about ·04 mm. in length. (iv) In the fourth row there are eight widely spaced setae, of which the middle pair is short and clavate, measuring only about ·014 mm. in length, while the three pairs to the sides of these are cylindrical, the inner two pairs measuring about ·036 mm. in length, the most lateral pair about two-thirds of this.

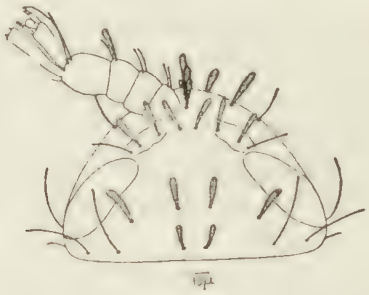

FIG. 1.
Head; dorsal view; right antenna removed to show the setae beneath it.

In addition to these setae, there are present three unpaired clavate setae, which are in a line with the median seta of the first transverse row; one of these, at the very tip of the head, is minute; the other two, between the bases of the antennae, are only a little shorter than the clavate setae of the first row.

Antennae (fig. 2). The distal segment of the antenna is much the longest, and is nearly twice the length of the third segment. There are two minute setae on

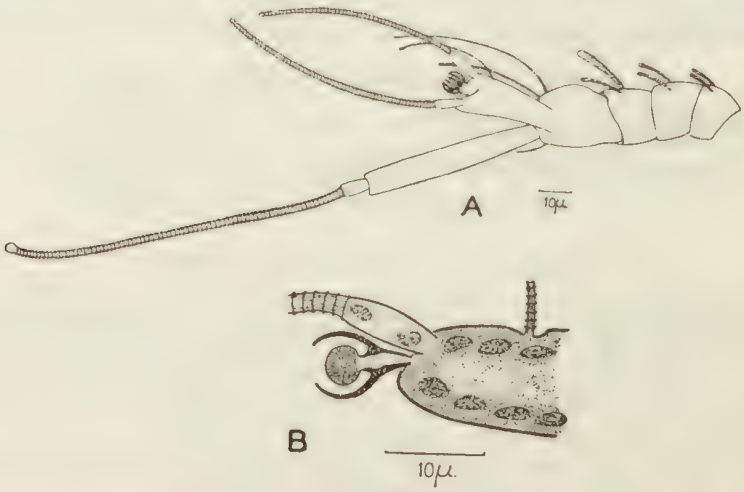

FIG. 2
Antenna.
A. Right antenna, ventral view.
B. Distal end of lower ramus, showing the globulus (from a microtome section).

each of the first three segments, just perceptibly clavate, except one on the third segment, which is markedly clavate and larger. On the fourth segment the two setae are long, slender and cylindrical; one is almost as long as the peduncle, the other about three-quarters its length. The upper ramus of the antenna is as long as the peduncle, and is very slender, its length being about eight times its breadth;

it is about half the length of its flagellum. The lower ramus of the antenna measures about five-eighths of the length of the upper ramus, and is about three times as long as broad; its anterior flagellum is only very slightly shorter than the posterior, and measures about 2½ times the length of the lower ramus. The globulus (fig. 2B) is comparatively small, and is about twice the width of its very short stalk.

Trunk. This is of medium build, being neither exceptionally slender, nor, compared with other species, markedly robust. It gradually widens up to the fifth segment, and beyond the seventh tapers more sharply.

The dorsal shields are approximately rounded, the first being about the breadth of the head. They are completely devoid of pubescence. The setae are cylindrical with blunt ends; and though some are slightly swollen at the tips, they are never markedly clavate. The six setae on the penultimate segment are all rather enlarged, and measure about one-third the breadth of the segment (fig. 3A).

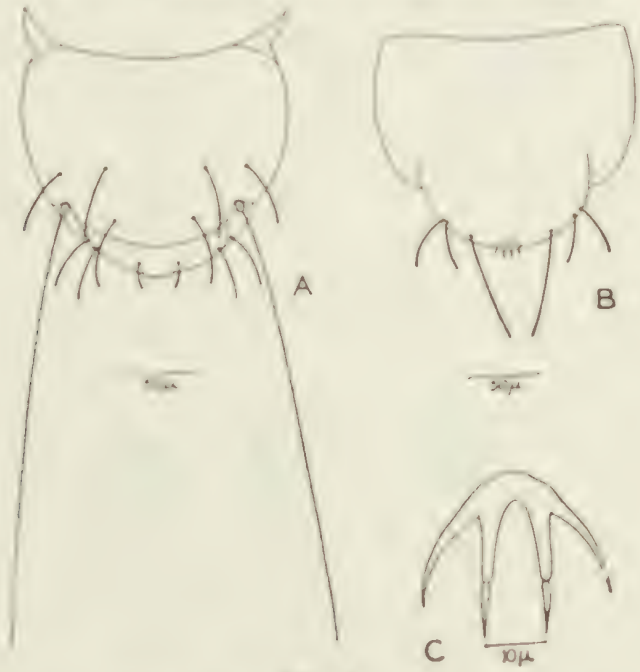

FIG. 3.

Posterior end of abdomen, showing setae and "anal plate."

A. Dorsal view (Tergal setae only shown).
B. Ventral view (Sternal setae only shown). Part of "anal plate" protruding.
C. "Anal plate."

The fifth pair of tactile setae (trichobothria) measures about 0·3 mm. in length, and is about twice as long as the breadth of the segment (fig. 3A); along its distal two-thirds is a very delicate close pubescence, but the proximal third is naked. The fourth tactile seta is a little less than four-fifths the length of the fifth; like the fifth it is faintly pubescent, the basal end alone being bare. The third seta is rather more than half the length of the fifth, and about three-quarters the breadth of its segment; it is faintly pubescent to within one-quarter its length from its base. The second and first setae are about half the length of the fifth, only the distal half being faintly pubescent.

Anal segment (fig. 3). At its posterior tip the tergum of the anal segment grows out as an inconspicuous thin protuberance above the "anal plate," but is not as

prominent as the protuberances that have been figured here for some species of *Pauropus*. The setae are all cylindrical, ending bluntly. The lateral and intermediate tergal setae are about equal in length, and about twice the length of the submedian setae. The distance between the two submedian setae is about the same as the distance between the submedian and intermediate setae and is about three times the distance between the intermediate and lateral setae.

Of the sternal setae the posterior are much the largest, and are about twice the length of the anterior tergal setae; the lateral sternal setae measure about the same length as the lateral tergal setae (fig. 3B).

The "anal plate" (fig. 3C) measures about ·025 mm. in length, and is furnished with four processes lying in the same plane. The median cleft, which extends

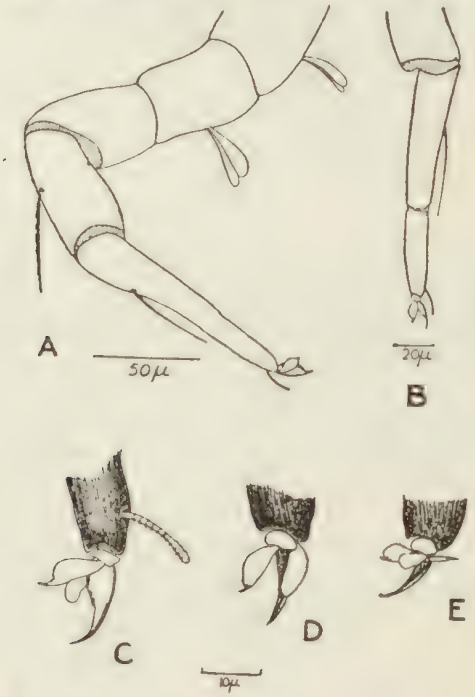

FIG. 4.
Leg.

A. Posterior leg.
B. Distal end of same, from a caustic potash preparation, chitin stained with eosin. Note incipient division of distal leg segment, indicated by constriction and thinning out of chitin (dotted).
C. Distal end of tarsus of left hind leg (external aspect).
D. The same (ventral view); note absence of posterior claw (posterior end to right).
E. Similar view of tip of tarsus of left sixth leg.

almost to the base of the plate, has a rounded ending. The two diverging outer processes curve inwards a little, and taper each to a point. The inner processes are rather thicker at the base; their distal end tapers into a narrow separately articulated and apparently very faintly pubescent segment.

The "styles" are thinner than the outer processes of the "anal plate," and are a little shorter than the submedian setae.

Legs (fig. 4). Like the dorsal shields these are completely free from pubescence. They increase considerably in length posteriorly, the last leg measuring about 0·3 mm. in length. The femur of the last leg (fig. 4A) is a little longer than the

trochanter, about half as long again as thick, and a little shorter than the tibia. The tibia is only a little longer than its seta. In the terminal segment of the last leg there is, as usual, no demarcation of a metatarsus from a tarsus. But a little beyond its middle there is recognizable, with various degrees of clearness in different individuals, a partial constriction with thinned-out chitin (fig. 4B). This constriction is also perceptible in some of the more anterior legs, but not so clearly as in the last. This incipient division of the tarsus is not confined to the present species. On this point Hansen (1) writes: "In some large species of *Pauropus* the tarsus of the ninth pair presents a faint indication of a division into two joints, but this spurious articulation or thin-skinned place is always situated outside the middle of the tarsus and has nothing to do with the sharp division into metatarsus and tarsus existing in the eighth and other pairs, in which the metartarsus is always much shorter than the tarsus."

The seta of the tibia of the last leg is tapering and pubescent. A similar but shorter seta arises from near the upper end of the tarsus. At the lower end of the tarsus is a very short cylindrical faintly pulgescent seta, about as long as the claw. The coxa and trochanter bear each a single biramous seta; in the more anterior legs the corresponding setae are uniramous.

The middle claw of all the legs is well developed; the posterior claw is small, and on the last pair of legs is not merely of diminished size, as in most species, but completely absent (cf. figs. 4C, D, E).

Locality. Belgrave, Victoria.

Type in National Museum, Melbourne.

Of the described species of *Pauropus* Harrison's *P. australis* seems to approach the nearest to the new species above described. In size both are about the same, though *P. australis* seems to be much more slender. Particularly striking is the general resemblance of the hind legs with its reduced number of claws,[1] the anal plate and the posterior setae. The head and antennae of *P. australis* have not been described with sufficient attention to those minute points of detail that are needed for the differentiation of species in *Pauropus*. On the principal points of difference Harrison is quite definite. In *P. australis* "the cuticle shows a fairly long pubescence on the last shield, anal segment, and posterior legs; a slight pubescence on the fifth shield; and is smooth in front of that"; in *P. silvaticus* the dorsal shields and the legs are completely free from pubescence. In *P. australis* Harrison found the first tactile seta (trichobothrium) to be "very coarsely plumose distally"; in *P. silvaticus* the seta is uniformly faintly pubescent along its distal half.

Habits.—The animals may be found under stones, fallen timber, or amongst the thick deposit of fallen leaves on the forest floor. They also enter rotting tree-trunks, half-decayed logs of tree-fern (*Alsophila, Dicksonia*) being particularly favoured. I have obtained several hundred out of a single such log. They select a damp environment, dry or wet surroundings being both avoided. They are light-shy creatures, and quickly run for cover when disturbed.

Oviposition takes place in the early and middle summer months, the eggs being scattered about singly in the decaying vegetation within which the animals live. The eggs are white and spherical,

1. Harrison's statement that it is the middle claw that is absent in the hind leg is probably an error; it is the normally diminutive posterior claw that becomes reduced in the ninth leg in all species of *Pauropus* (Hansen, 1901), and has completely vanished in *P. silvaticus*.

extremely minute, measuring seldom more than 0·11 mm. in diameter. All the larval stages, comprising animals with 3, 5, 6 and 8 pairs of legs can be found in abundance during the summer, in places where the adults are prevalent.

There is no evidence that the animals are predaceous, as some writers on *Pauropus* have inferred from the activity of their movements; nor do they seem to ingest solid vegetable material, for this is not recognizable in the distended intestine. The latter, indeed, contains nothing but fluid material. It seems that *Pauropus* subsists upon organic matter dissolved in the juices of the rotting vegetation within which it lives.

Despite the agility of their movements the animals are much preyed upon by the more slowly moving pedipalps and predaceous mites that form part of the associated microfauna; and I have occasionally seen even adult animals that have fallen victim to their attack.

Unlike one of the species described by Harrison (*P. amicus*), it cannot be said of *P. silvaticus* that it is markedly sociable in its habits. In captivity, it is true, the animals sometimes congregate under fragments of leaf or wood in the breeding receptacles, but I have not encountered this under natural conditions. Nor do the animals exhibit the remarkable maternal instinct of guarding their eggs, as observed by Harrison in *P. amicus*; indeed, the eggs are not laid in clumps, but, as already stated, are scattered about singly and at random amongst the rotting vegetation in which they live.

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THE KORALEIGH STONY METEORITE

By A. B. Edwards, D.Sc., and G. Baker, M.Sc

Introduction

The stony meteorite (aerolite) herein described was found by Mr. F. A. Cudmore in March, 1943. It had been ploughed up from red soil near Koraleigh, in New South Wales, about twenty miles north-west of Swan Hill. The meteorite was submitted to us for mineralogical investigation by the Director of the National Museum, Mr. D. J. Mahony, and is now lodged in the National Museum, Melbourne.

General Description

The Koraleigh meteorite is only part of the original mass, since one of its six faces is a more or less flat fracture surface.

The weathered nature of the meteorite indicates that it has lain in the soil for a considerable period of time. Its rust-coloured exterior is due partly to reddish-brown limonite, and partly to small attached particles of red soil. During its period of burial, small particles of soil and occasional well-rounded grains of quartz became cemented on to surfaces of the aerolite by the iron oxides formed from the weathering of its metallic constituents.

The meteorite is irregular in shape, with six surfaces of varying size. Several of the surfaces show the "thumb-marks" so characteristic of meteorites. On one of the surfaces, a circular depression, measuring 7 mm. across, marks the position from which a hemispherical chondrule has broken out since the meteorite was collected. The flat base of this chondrule was on the outside of the aerolite, and may therefore have resulted from weathering. It was most likely spherical in its original condition.

The size of the meteorite is 9·3 cm. x 5·7 cm. x 5·0 cm. across its major dimensions. The mass weighed approximately 450 grams before slicing for mineralogical examination. Its specific gravity was determined as 3·41. This value is similar to that of the Caroline stony meteorite recently described in these Memoirs (Stillwell, 1941). Freshly fractured surfaces of the meteorite are dark brown to dark grey. Small soft patches of light-brown limonite are irregularly distributed through more weathered areas. The fresher surfaces show that minute patches of metallic minerals are disseminated throughout the meteorite.

Mineralogy

A thin section of the aerolite revealed that it is principally crystalline, with a granular to micro-porphyritic texture. Considerable staining by secondary hydrous oxides of iron has taken place right through the specimen.

The greater portion of the silicate minerals consists of granular olivine and crystals of bronzite with 2V approximately 90°. Occasional chondrules of the barred monosomatic variety and of the radiating and granular polysomatic variety are present. Twenty chondrules occurred in one thin section, measuring $\frac{1}{8}$ in. x $\frac{5}{8}$ in. The types of chondrules are similar to those occurring in the Bond Springs stony meteorite from Central Australia (Baker and Edwards, 1941), though they are not as numerous. The largest chondrule observed was the detached one measuring 7 mm. across; the smallest measured approximately 1 mm. in diameter.

Metal and iron sulphide grains are scattered throughout the section as small patches of irregular shape. They are frequently enveloped by limonite, the metal more so than the sulphide minerals.

The volume percentages of the silicate minerals and of the metal + sulphide were determined from 14 traverses, taken at 1 mm. intervals across a thin section, by means of an integrating machine. This resulted in a value of 9·7% for the metal + sulphide, with the sulphide mineral considerably in excess of the metallic iron. This percentage value is lower than that for the Bond Springs aerolite (12% by volume), partly because of considerable alteration by weathering of the iron in the Koraleigh aerolite.

The silicate minerals and small amounts of glassy material comprise the remaining 90·3% by volume of the aerolite. They have suffered slight decomposition, occasional alteration products (probably serpentine and iron oxide dust) occurring along cracks in some of the olivine crystals. They are invariably stained by thin films of secondary iron oxides derived from the metallic constituents.

Rare interstitial areas with low birefringence and vague twin lamellae are probably plagioclase felspar. Some of the clear areas between the grains and crystals of olivine and bronzite are uniaxial, negative, and probably correspond to the sodium-calcium phosphate mineral, merrillite, the presence of which was established by Stillwell in the Caroline stony meteorite.

Other rare interstitial areas which are clear and principally isotropic, represent maskelynite or devitrified glass. As in the Caroline stony meteorite, minute particles of reddish-brown colour and isotropic character, included in the olivine and pyroxene

crystals, are regarded as chromite. Small opaque inclusions in certain of the olivine crystals are probably metallic iron and sulphides. Occasional rounded grains of a diopsidic mineral are also associated with the more abundant crystals of the silicate minerals.

Two varieties of pyroxene are present. One is the orthopyroxene, bronzite; the other shows oblique extinction, up to 36°, so that it is a clinopyroxene, probably augite. The orthorhombic variety is the more common of the two. Some of the pyroxene crystals exhibit wavy extinction, indicative of strain; rare examples of the clinopyroxene display lamellar twinning.

Opaque Minerals

The opaque minerals in the meteorite are pyrrhotite, α-iron (kamacite), limonite and (?) chromite. Pyrrhotite, the most abundant of the opaque minerals, forms areas which may be as large as 0·12 mm. x 0·25 mm. across, but are more commonly 0·10 mm. x 0·10 mm. in size. In reflected light, the pyrrhotite appears pinkish-brown. It is pleochroic and anisotropic. It can be distinguished from troilite by its etching properties. The pyrrhotite is relatively inert to 1 : 1 HNO_3 and 1 : 1 HCl, whereas troilite effervesces vigorously with these reagents. It was found by Stillwell (1941) that the sulphide mineral in the Caroline stony meteorite was also pyrrhotite.

The iron occurs as corroded remnants of grains which were originally equidimensional with the pyrrhotite, but are now partly altered to limonite. The iron is readily etched with HNO_3, $FeCl_3$ and $HgCl_2$, which indicates that it is α-iron (kamacite). No γ-iron (taenite) was detected. Small amounts, presumably of this mineral, were thought by Stillwell (1941) to occur in the Caroline aerolite. The iron is occasionally intergrown with pyrrhotite, but it is more usual for the two to occur as isolated grains.

The limonite commonly forms rims enclosing residual areas of iron. These rims are much more pronounced about the iron grains than around the pyrrhotite. They are connected with small veinlets of limonite which traverse the meteorite, and with a fine meshwork of limonite threads or films from 0·001 mm. to 0·002 mm. wide, which fill almost every grain boundary between the transparent minerals. The limonite occasionally forms parallel, needle-like inclusions and veinlets through the pyrrhotite.

Trevorite, which was recorded among the oxidation products of the metallic iron of the Caroline aerolite (Stillwell, 1941), was not located in the Koraleigh specimen.

The mineral which is thought to be chromite occurs as small,

more or less idiomorphic crystals up to 0·02 mm. in diameter. It is grey-brown in reflected light, isotropic, and inert to standard etching reagents. The small crystals sometimes occur as groups within a single grain of the silicate minerals.

Conclusion

The aerolite from Koraleigh, in New South Wales, is a bronzite-olivine chondrite like that from Caroline, on the Glenelg River near the Victorian-South Australian border. Because of the close similarity of these two aerolites in the various characteristics examined, it is thought probable that they may have close genetic relationships, and might even be portions of the same fall, as the Caroline aerolite was found at the site of a blackfellows' camp, and had therefore possibly been transported from its original place of fall.

References

1941 Baker, G., and Edwards, A. B. The Bond Springs Stony Meteorite. Mem. Nat. Mus., Melbourne, no. 12, pp. 49-58, 1941.

1941 Stillwell, F. L. The Caroline Stony Meteorite. Mem. Nat. Mus., Melbourne, no. 12, pp. 41-48, 1941.

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